CORPUS CHRISTI BEACH

a coastal management beach access pilot study

CORPUS CHRISTI BEACH

a coastal zone management pilot study of beach access and conservation - waterfront housing, recreation and tourism

prepared in cooperation with the City of Corpus Christi by an Interdisciplinary Team of Graduate Research Assistants of Texas A&M University, under the supervision of Dr. Wolfgang G. Roeseler, Head of the Department of Urban and Regional Planning; and in association with Dr. Christopher Mathewson, Professor of Geology. Ernest Briones, Director of Planning and Urban Development directed the City's participation.

Team: Texas A&M University

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Team: City of Corpus Christi

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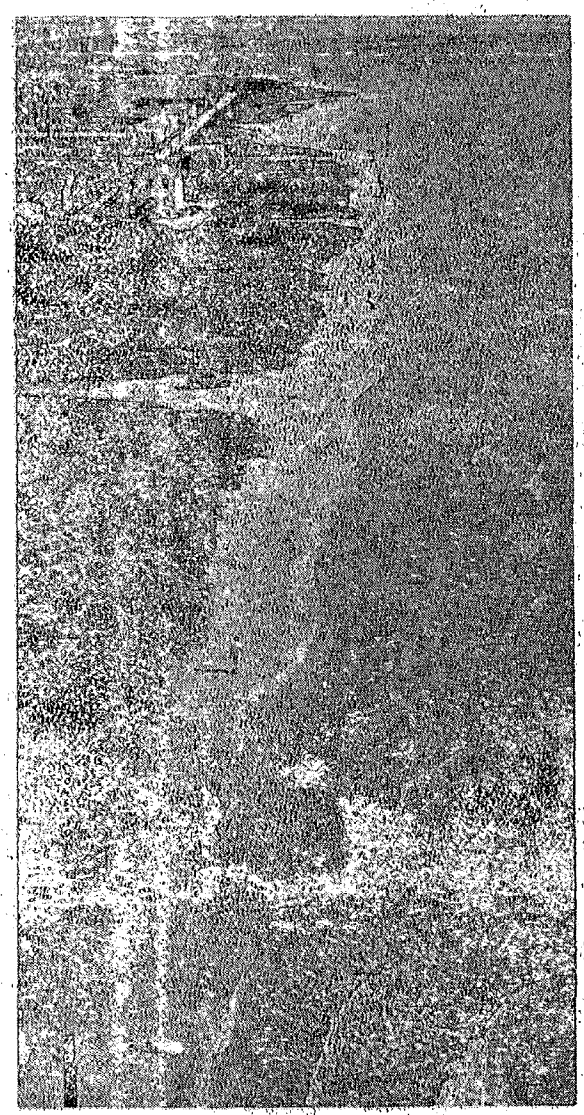


Purpose & Objectives

PURPOSE AND OBJECTIVES

The Coastal Zone Management Act of 1972 (16 U.S.C 1451), authorizes a wide variety of exploration and conservation measures concerning the vast coastal regions of the United States. The act and its numerous programs are administered by the Office of Coastal Zone Management (OCZM), National Oceanic and Atmospheric Administration, of the U.S. Department of Commerce.

In Texas, for valid and compelling reasons, the thrust of coastal management activities has been the exploration of oil and gas resources on the continental shelf. There exists, however, another area of public concern covered by the federal statute and that is the providing of beach access for recreational purposes in general, for tourism, and for waterfront development, particularly housing. Geologic and man-made constraints provide formidable obstacles to the orderly and rational development of beach areas along the west and north coastline of the Gulf of Mexico in the states of Texas, Louisiana, Mississippi, and Alabama. Conditions here are substantially different than those found in Florida and along the east and west coasts of the continental United States. OCZM considers beach access in this context to be the key issue in a very broad sense, extending beyond physical participation in recreation activities and

encompassing "visual, legal, social and economic access. The barriers that inhibit them, and the tools that are available to enhance them."

The desirability of coastal management involvement in beach access programs was recognized by Texas A&M University and confirmed by the state's Coastal Management Office, under the direction of Mr. Robert Armstrong. Funding, however, had been previously committed to continuation of the resources exploration programs and would have to be secured directly from the U.S. Department of Commerce. It was agreed that the orderly development of coastal areas would be of substantial public interest in Texas and would provide for relaxation and recreation of the citizens living in the general region of which these coastal areas are an integral part and which can be reached conveniently by automobile within one day. It was also recognized that the economic impacts of orderly development of tourism and Gulf shore recreational facilities would be substantial and would provide job opportunities for local residents. Job opportunities would be particularly advantageous for Mexican-Americans. The tourist industry everywhere, including in the Miami, Florida area, has demonstrated repeatedly its ability to absorb large numbers of foreign-born workers under favorable conditions offering substantial economic opportunities, not as much impaired by the language barrier as other activities.

On the basis of these general conclusions, the Department of Urban & Regional Planning at Texas A&M University decided to undertake a pilot study in order to develop general guidelines and criteria for a broader based, more comprehensive research effort to be undertaken later. For the pilot project, a complex area was selected which involves not only the full spectrum of natural constraints of beach development, but also the intricate metropolitan urban aspects that had to be recognized and taken into account in developing standards and guidelines for orderly growth. The area most appropriate for this initial effort was the Corpus Christi Beach section in the City of Corpus Christi, and a program was initiated by the Department and the City of Corpus Christi to examine the range of problems and to develop solutions and guidelines at least in concept. The project was carried out over a period of 10 months, and this final project report presents the principal observations and findings.

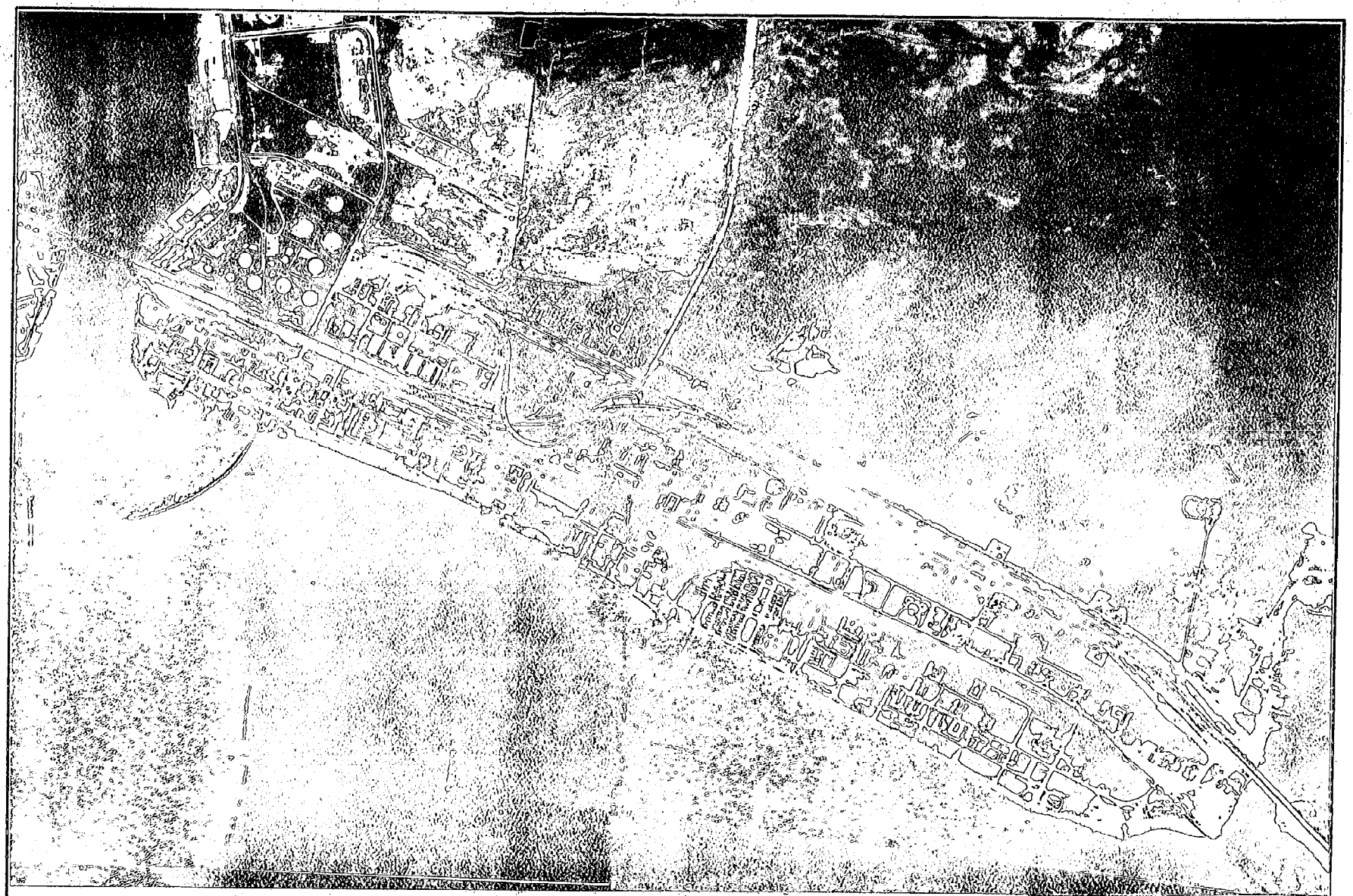
The Corpus Christi Beach pilot study consisted (a) of a comprehensive assessment of the physical - geologic environment, followed by an analysis of man-made development; (b) of a series of concepts of solutions to reflect a variety of objectives; and (c) of technical provisions for possible regulatory measures.

The principal objective held in view was the providing of waterfront access for public

and commercial recreation, apartment housing and tourist facilities under conditions compatible with sound practices of conservation, flood protection, engineering, architecture and urban planning in general. The timing of the pilot study was input prompted by a beach restoration project of the U.S. Corps of Engineers for which construction contracts were led earlier this year.

Within the limited scope of this pilot study, an attempt was made to gain better insight into the interactions of natural and man-made conditions and circumstances. Also, to develop in concept, clearly discernible methods of approaching each major component and the total issue that underlies any effort to improve waterfront accessibility.

The University, in cooperation with the Department of Community Development and Planning of the City of Corpus Christi, feels that it has accomplished its objectives and has, indeed, produced a pilot study within the scope outlined herein. The following pages describe the results of this investigation.



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DATE OF PHOTOGRAPH
AUG. 5, 1965

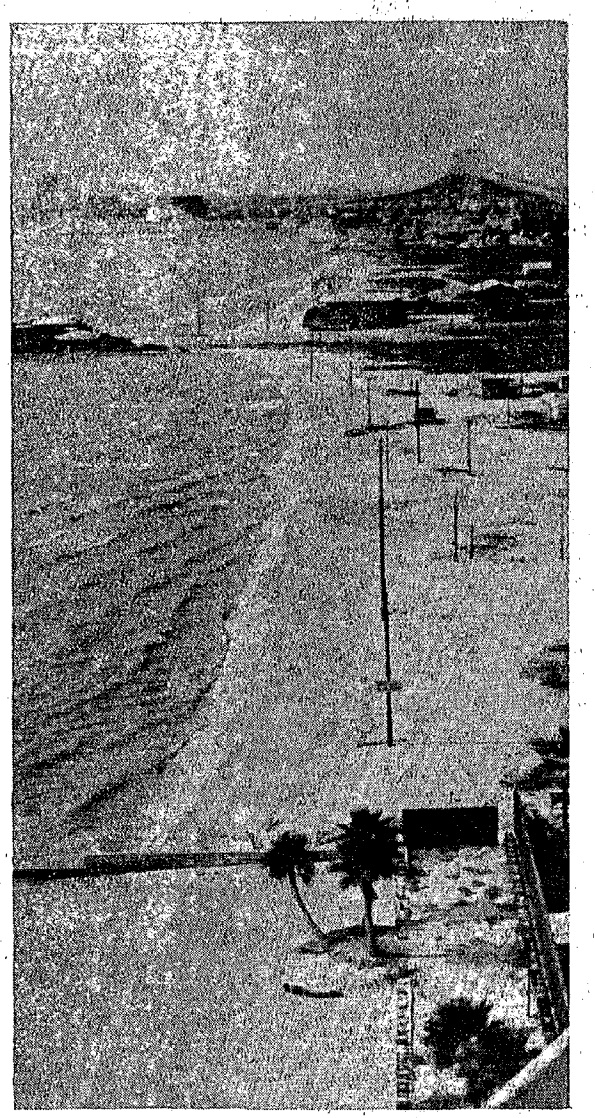
CORPUS CHRISTI BEACH, TEXAS
(RESTORATION PROJECT)

AERIAL PHOTOGRAPH

SCALE IN FEET

800 400 0 800

EXHIBIT 5 APPENDIX II



Research & Analysis

METHODOLOGY

The methodology of this study relates to five steps as follows:

Initial Orientation
Research
Analysis
Design
Implementation

Initial Orientation was accomplished through a series of briefings by the city planning staff of Corpus Christi accompanied by comprehensive slide presentations. A review of previous pertinent studies and of available records was included.

Research consisted of compilation of data from sources of the City of Corpus Christi; the Coastal Management Office of Texas; the U.S. Corps of Engineers; the United States Geological Survey; the Coastal Bend Council of Governments; records of Texas A&M University; and others. In addition, geologic and land use field surveys were made to round out the data and information base.

Analysis consisted of in-depth review of the research data with emphasis on geologic conditions, including flood and storm histories, currents, soils, land use, building conditions and other pertinent physical conditions and economic data. Problems and constraints were identified.

A visual site analysis was made to identify existing and potential points of interest and liabilities. The several routines and sub-routines of this phase produced an environmental assessment which provided the basis for design solutions.

Design efforts resulted in a synthesis of the analytical facts and produced several solutions which would appear to be physically and economically feasible. Implementation as outlined means of attaining the design objectives.

CITY OF CORPUS CHRISTI

Corpus Christi is located in southern Texas about 210 miles southwest of Houston, 145 miles southeast of San Antonio, and 160 miles north of Brownsville which is on the Mexico border. Corpus Christi consists of 326 square miles, including 105 square miles of land and 221 square miles of water. The overall average altitude is 35 feet above mean sea level. The city was incorporated in 1852; a Home Rule Charter was adopted in 1909, and the Council-Manager form of government in 1946. The population in 1970 was 204,525 and for 1975 the estimate was 214,307; the expected population for 1980 is 221,760.

The Corpus Christi area is serviced by air routes provided by Braniff, Eastern and Texas International. Continental Trailways and Greyhound provide bus service. The highway system running to or through the city consists of Interstate 37, U.S. 77, and 181, Texas 9, 43, 44, 286, 357, 358, and 665.

Freight is moved by rail, truck and ships. Rail service is provided by the Missouri Pacific, the Southern Pacific, the Texas-Mexican lines. Motor freight consists of eight truck line companies. Water oriented freight movement is represented by 149 cargo carriers; 99 bulk cargo carriers and 50 canal barges that offer service to and from

Corpus Christi within the Intracoastal Canal. The port of Corpus Christi is the deepest on the Gulf of Mexico, at 40 feet.

Electricity is provided by the Central Power & Light Co.. Water is furnished by the city from Lake Corpus Christi at Mathis. Gas is also provided by the city.

Corpus Christi has 160 churches, nine hospitals with a total of 1609 beds, more than 70 hotels with 4000 rooms and three libraries with approximately 310,000 volumes. There are five school districts in the area with a combined enrollment of 52,000. Six institutions of higher education serve Corpus Christi: Del Mar College, east and west campus, Texas A&I University, Southwest Research Institute, Texas A&M University Research and Extension Center, and the University of Texas Marine Science Institute.

For recreation and entertainment, Corpus Christi offers 21 theaters, including eight drive-ins, two public and five private golf courses, Memorial Coliseum with seating for over 6000 people and Del Mar Auditorium Exposition Hall. There are over 160 parks ranging from 1 to 80 acres in size, with picnic facilities, fishing piers, swimming pools, bicycle trails, playgrounds. Other features include a marina, salt and fresh water fishing, boating, sailing, water skiing, tennis, auto racing, skin diving, theater groups, a symphony orchestra, the Art Museum of South Texas and the Corpus Christi Museum.

Six major industry groups constitute the economic base of the city: agriculture, fishing, manufacturing, defense - the U.S. Naval Air Station and the Corpus Christi Army Depot - the oil port and tourism. Some 150 manufacturing establishments employ approximately 11,500 workers. The principal products are petroleum refined products, primary metals, stone, clay and glass products, chemicals and allied products, apparel and electronic components. The value added by manufacturing products is approximately $279 million annually.

Pertinent characteristics of this most pleasant city on the Texas coast are shown on Plates 1, 2 and 3.

POPULATION GROWTH 1990

CORPUS CHRISTI, TEXAS

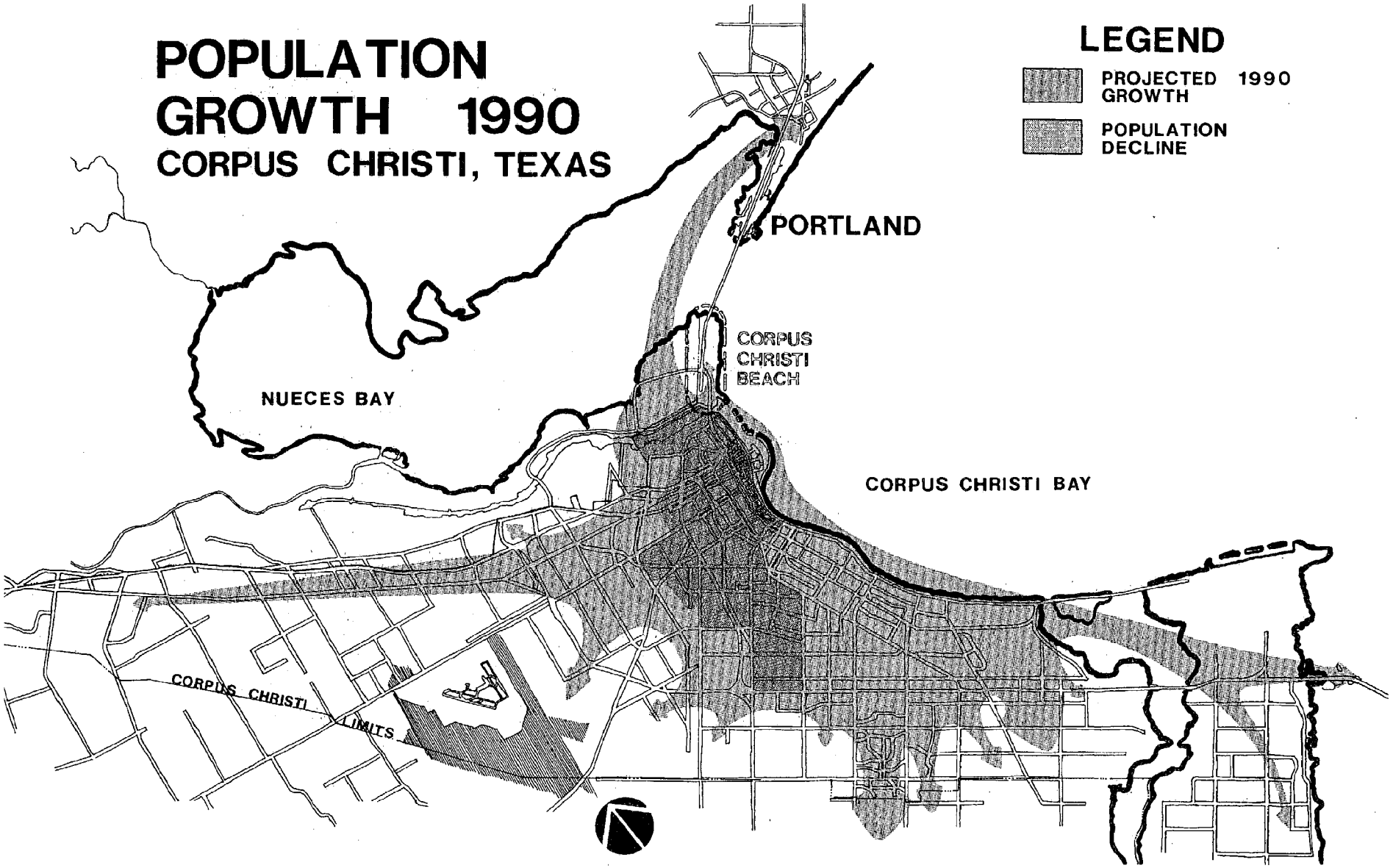


plate1

CIRCULATION

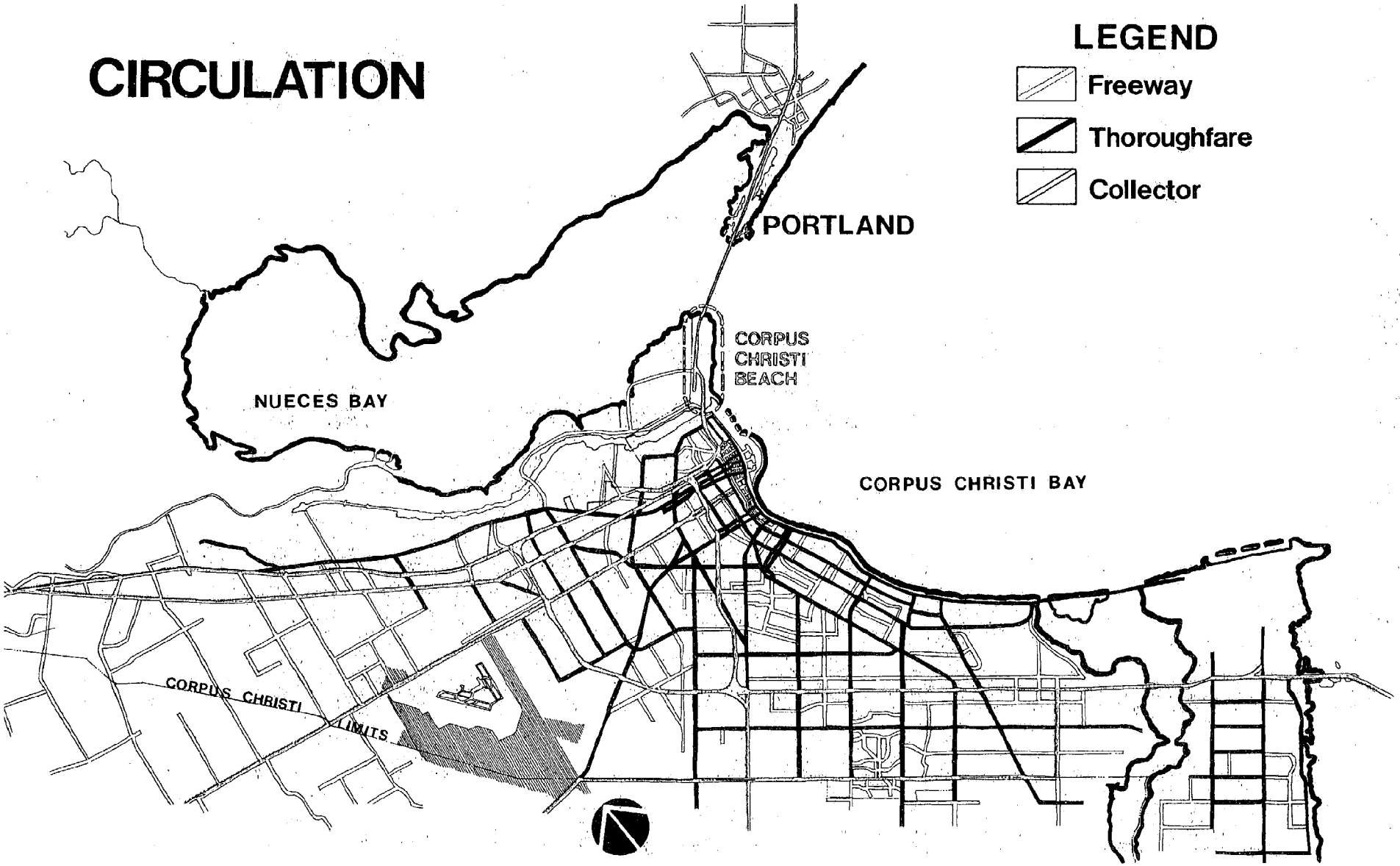


plate 2

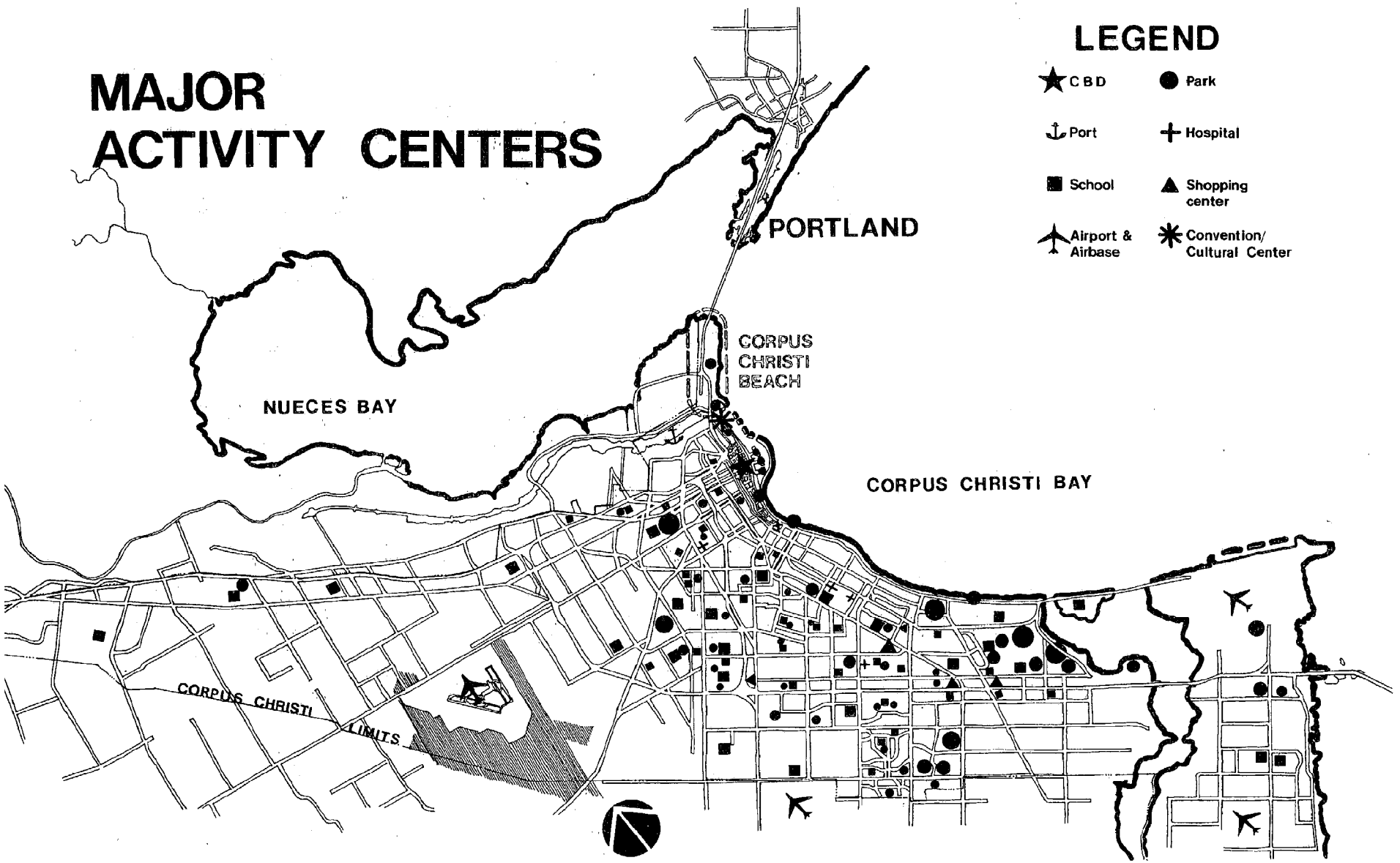

MAJOR
ACTIVITY CENTERS
LEGEND
CBD
Park
Port
Hospital
School
Shopping center
Airport & Airbase
Convention/ Cultural Center
PORTLAND
CORPUS CHRISTI BEACH
NUECES BAY
CORPUS CHRISTI BAY
CORPUS CHRISTI LIMITS

plate 3

NUECES COUNTY

Nueces County, Plate 4, located in the coastal bend region of Texas on the Gulf of Mexico was organized in 1846. Its only river, the Nueces River, forms most of the northern county line; Jim Wells County forming the west and Kleberg County forming the south and southwest. Also, included in Nueces County boundaries are the northern point of Padre Island, Mustang Island and all of Corpus Christi Bay.

Nueces County is 841 square miles of relatively flat land with rich soil. Its coastline is broken with bays.

The major modes of transportation servicing the County include highways, air routes, railroads, and sea routes. Nueces County produces annually an average of $100.4 million in gas, oil, shell, cement, lime and stone. Since 1930 more than 460 million barrels of oil have been produced here. There also exist large petrochemical plants.

In agriculture, an average annual income of $40 million is earned; 80% from grain, sorghums, and cottons. Among the livestock within the county, beef, dairy cattle, hogs and poultry are the most productive.

Corpus Christi is the county seat, as well as the largest city. The population of Nueces County, estimated in 1973, was 250,800; 215,000 live within the corporate limits of this city.

NUECES COUNTY

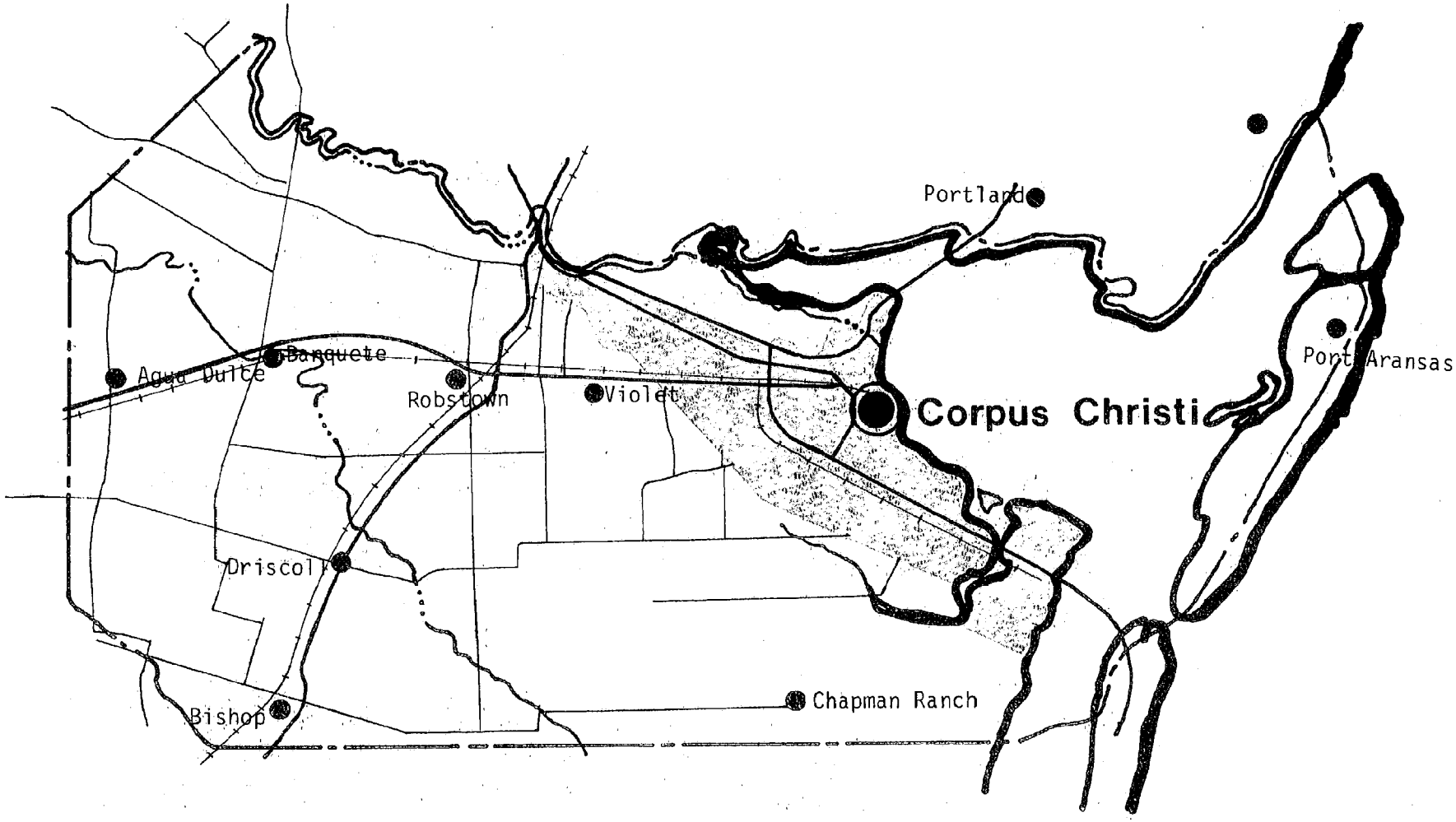


PLATE 4

REGIONAL TRANSPORTATION

Transportation in the State of Texas is ranked among the finest in the nation. As shown in Plate 5, Texas has a vast system of transportation facilities. There are about 250,000 miles of roads, more than 13,000 miles of railroad lines and 1,200 public and private airports. The Texas coastline is served by the Gulf Intercoastal Waterway, and by 13 major ports.

Consequently, transportation of people and goods is a major industry in Texas. Statistics from County Business Patterns and the Association of American Railroads for 1973 indicate that the transportation industry employed nearly 160,000 Texans and generated an annual payroll of more than $1.5 billion. Trucking and warehousing is the largest segment of the commercial transportation industry in Texas with over 69,000 employees. Railroads rank second with nearly 29,000 persons on the payroll. Air and water transportation each employ 20,000 workers.

The commercial transportation industry statistics do not reflect the vast investment in private transportation facilities and equipment. Private automobiles, trucks and aircraft are highly significant in the Texas transportation system. The dominance of the private automobile in passenger transportation here is well known.

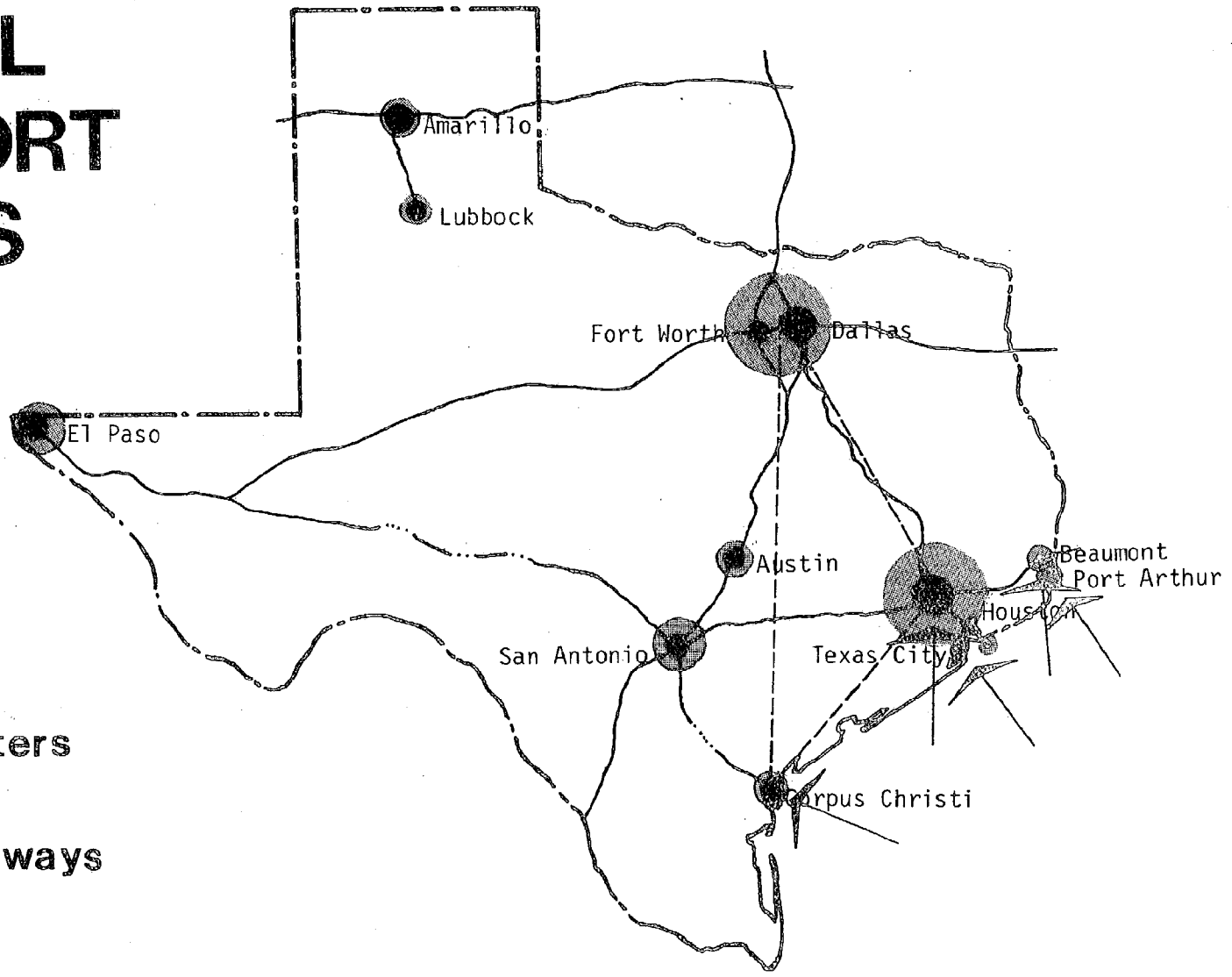
CLIMATE DATA

The State of Texas has a wide range of climatic conditions (Plate 6). However, the most pertinent information is that which relates to the cost, and particularly that which affects Corpus Christi and its hinterland.

Average annual rainfall along the coast ranges from 30 inches in Kleberg County to 35 inches in Aransas County. Inland, average annual rainfall ranges from 27 inches in Kleberg County to about 30 inches in Bee County. Corpus Christi averages about 28.5 inches of precipitation annually. The average annual rainfall from 1931-1960 shows a progressive increase eastward across the coast from 27 inches in the southwest to 35 inches in the southeast.

Temperatures range from a January or average winter minimum of 44 F. in Refugio and San Patrico Counties, to a July or average summer maximum of 97 F. in Jim Wells County. Counties along or nearer to the Gulf of Mexico, such as Aransas and Nueces Counties, registered an average winter low of 47 F. to average summer highs of 92 F. Between 1931 and 1960 the average annual mean face-air temperature in the Corpus Christi area was between 70 and 72 F.

REGIONAL TRANSPORT SYSTEMS

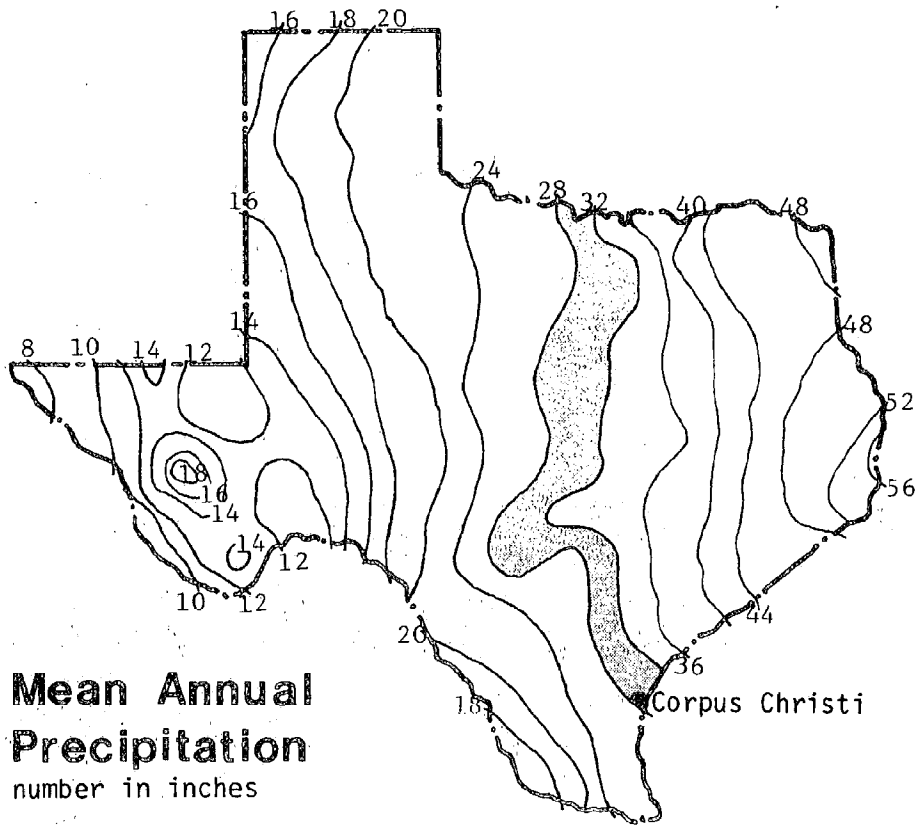


LEGEND

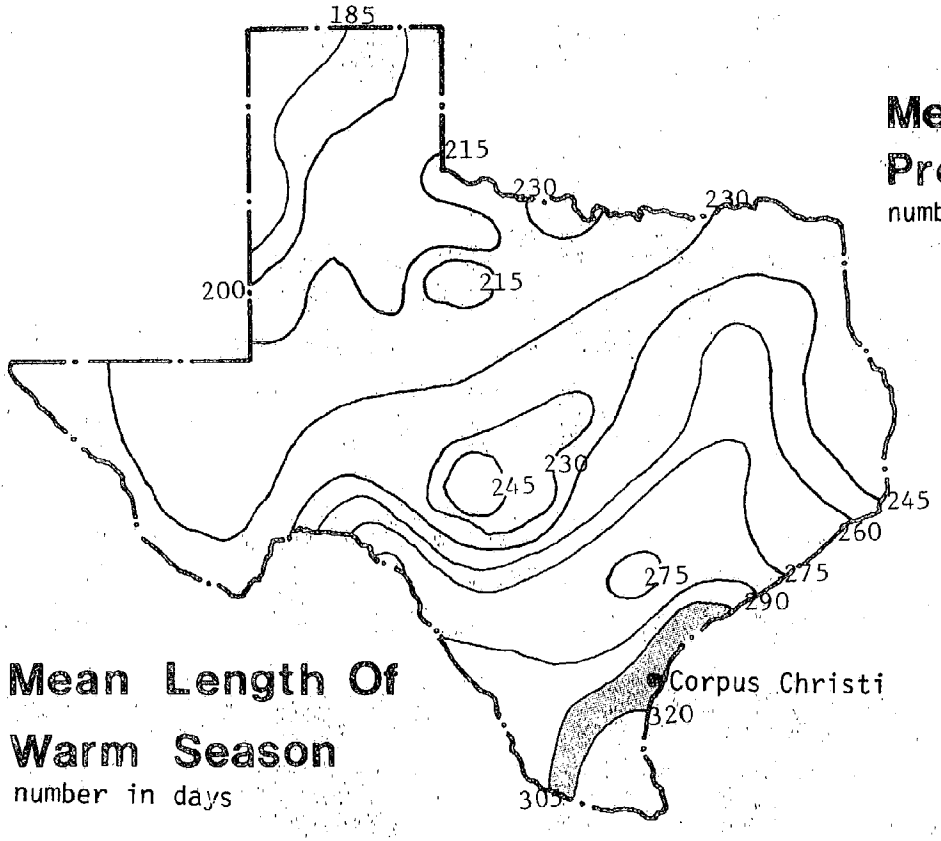
- Urban Centers
- Major Highways
- Air Route
- Sea Ports

PLATE 5

CLIMATIC DATA



Mean Annual Precipitation
number in inches



Mean Length Of Warm Season
number in days

PLATE 6

MARKET AREA

The restoration of the Corpus Christi Beach furnishes Corpus Christi with the potential of attracting its share of visitors from a considerable part of midwestern United States and, of course, from the harshest regions of Texas. A large number of winter vacationers from these areas find the warm subtropical climate and the generally reasonable living costs of Corpus Christi attractive, (Plate 7).

Moreover, there is an international market of Mexicans seeking U.S. coastal resort establishments as vacation sopts. As a growing market and with the strategic closeness of Corpus Christi to Mexico, it is conceivable that this may become a major factor in the development of Corpus Christi as a resort with an international milieu.

The Texas Office of Business Economics considers the key zone of affluence to be the City of Corpus Christi and an eight-county area surrounding it. It is anticipated that most of the demand for recreation facilities and services of Corpus Christi Beach would be generated within this immediate area which is generally within an hour's driving distance from Corpus Christi proper.

MARKET AREA

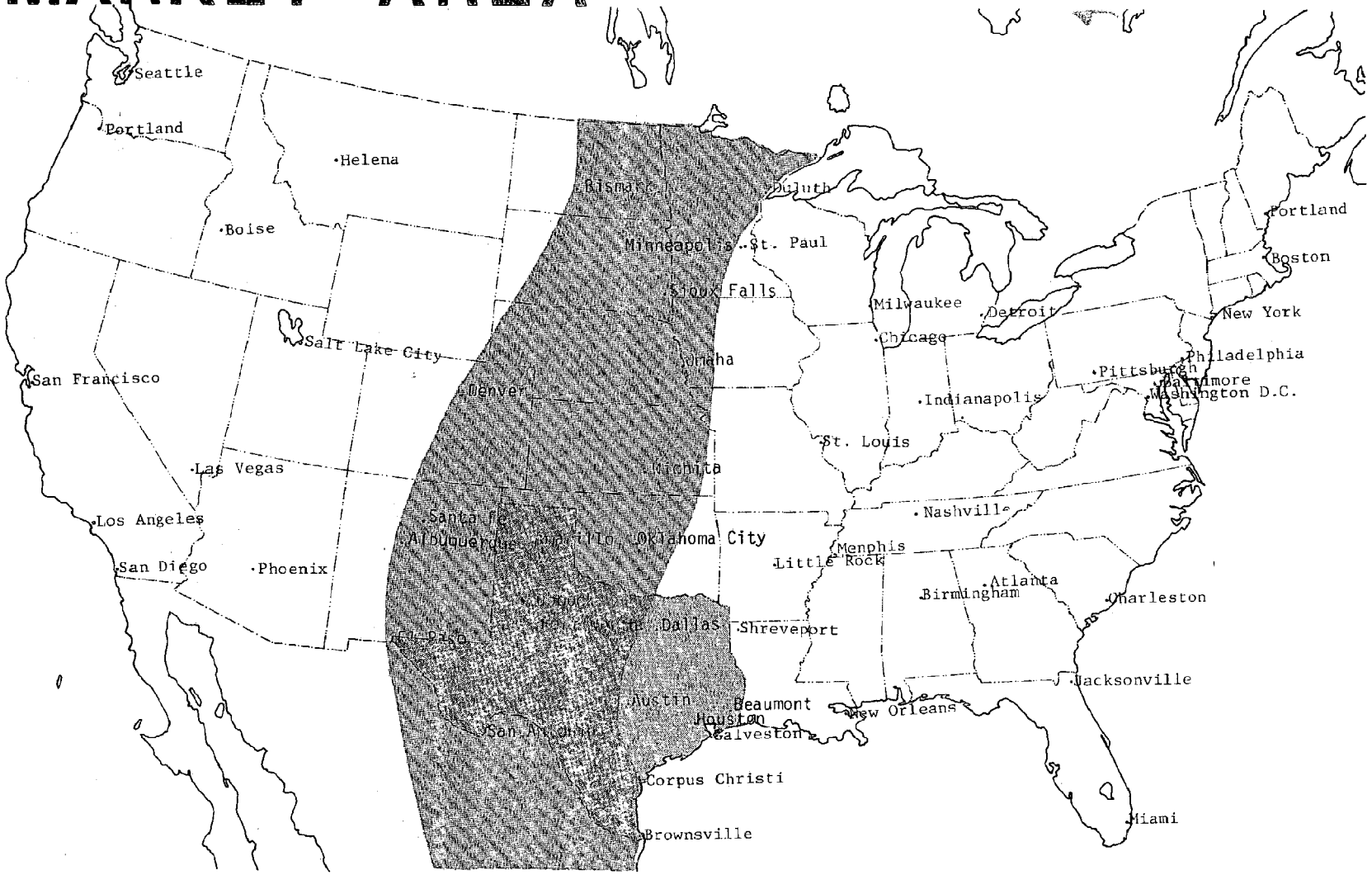


PLATE 7

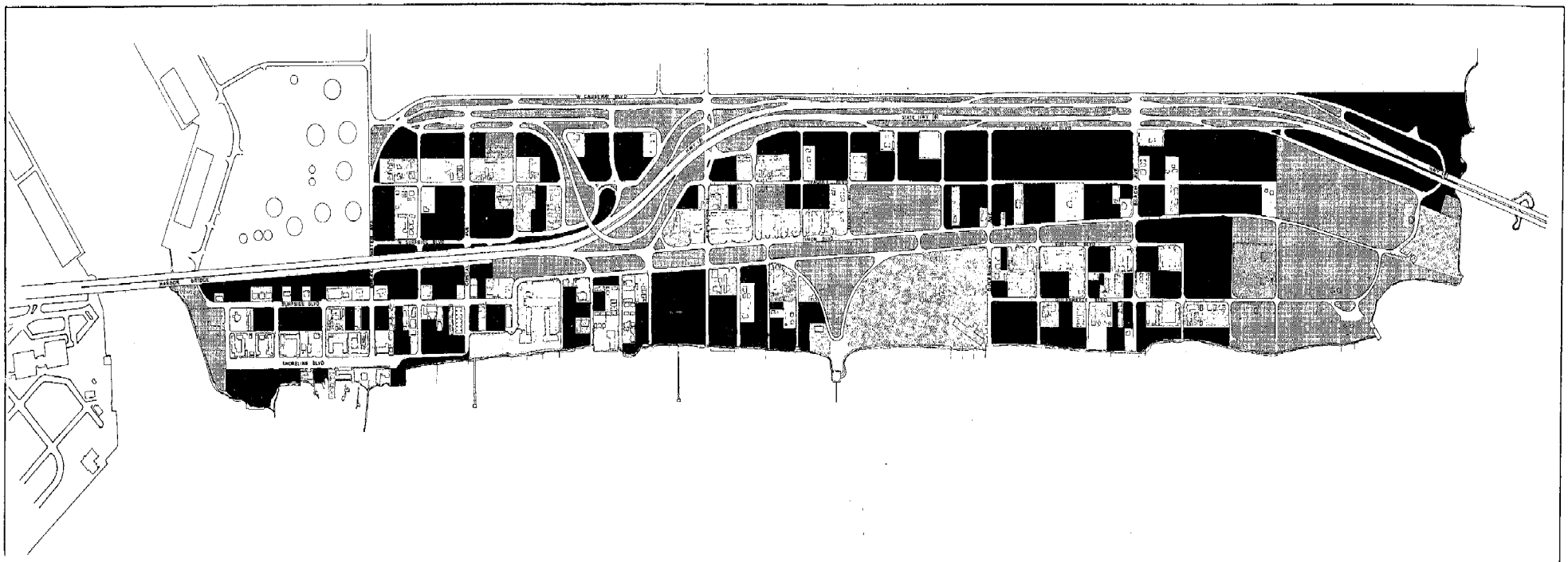
CORPUS CHRISTI BEACH TODAY

As one approaches Corpus Christi Beach from downtown Corpus Christi, via the striking steel arch bridge over the ship channel, one becomes immediately aware of the great tragedies that have wiped out substantial development on several occasions. The scars of repeated hurricanes, which heavily damaged the area, are still all too noticeable.

The area comprises approximately 360 acres; 178 of which are streets and easements, 40 acres public land, 35 acres in residential use and 86 acres are undeveloped. Corpus Christi Beach is in a general state of deterioration and decline. Incompatible land uses appear to be strewn over the area, (Plate 8). Some commercial uses exist, however they are scattered and do not form any type of effective commercial complex. A five-block area, between Canal Avenue and Coastal Avenue, was once the commercial hub of this beach. That has long since disappeared. Today, limited motel and curio shops exist of marginal character. Large sections of this land are vacant, or underused from an economic point of view. Timon and Surfside Boulevards once served hotels, which lined these banks from end to end. Today, little remains, except near the exit range of Highway 181. This once active area is now blighted. The previously prosperous rental properties, single and multiple family units in particular, are now suffering from deterioration and lack of use.

The general appearance of the nieghborhood is one of decline and obsolescence. The street pattern, Plate 9, is out of scale with the properties to be served. They are also in a poor state of repair and lacking good surfacing, curbing, lighting and landscaping. Utility lines are 40-50 years old, and have in part deteriorated. All utilities come directly from Corpus Christi, beneath the ship channel. These lines are said to be in poor condition. If development is to occur, the entire service system would need to be upgraded or replaced to support the area properly. Corpus Christi Beach's fire station has been abandoned. There is, of course, no longer a need for a school. Of the two theaters, one is now used for meetings, the other is abandoned. There are three public parks. However, only one has landscaping and recreational equipment. A tourist center is run by the Kwainas Club during tourist season. The remaining buildings are often in a delapidated state of affairs, certainly technologically obsolete and of lettle use value as evidenced by the number of abandoned buildings. Residual residences survive, and undoubtedly in anticipation of someone coming along to assemble the property for a more productive purpose. Land generally is under-used as indicated by Plate 9-1.

Little has happened in the Corpus Christi Beach neighborhood in recent years, with the exceptions of a few noteworthy and undoubtedly complex, yet successful, efforts of reclamation. One such example is the Las Brisas condominium; the other the Master Host Motel. The condominium, a



CORPUS CHRISTI BEACH
DEVELOPMENT GUIDE PLAN

- P.G. GONZALEZ - ARCHITECTURE - RESEARCH ASSISTANT/TEAM LEADER
- W.J. GENTILE - URBAN PLANNING - RESEARCH ASSISTANT
- J.K. KENNEDY - GEOSCIENCE - RESEARCH ASSISTANT

UNDER THE SUPERVISION OF DR. W.G. ROESELER, HEAD URPL

URPL DEPARTMENT OF URBAN PLANNING TEXAS A&M UNIVERSITY

EXISTING LAND USE

LEGEND

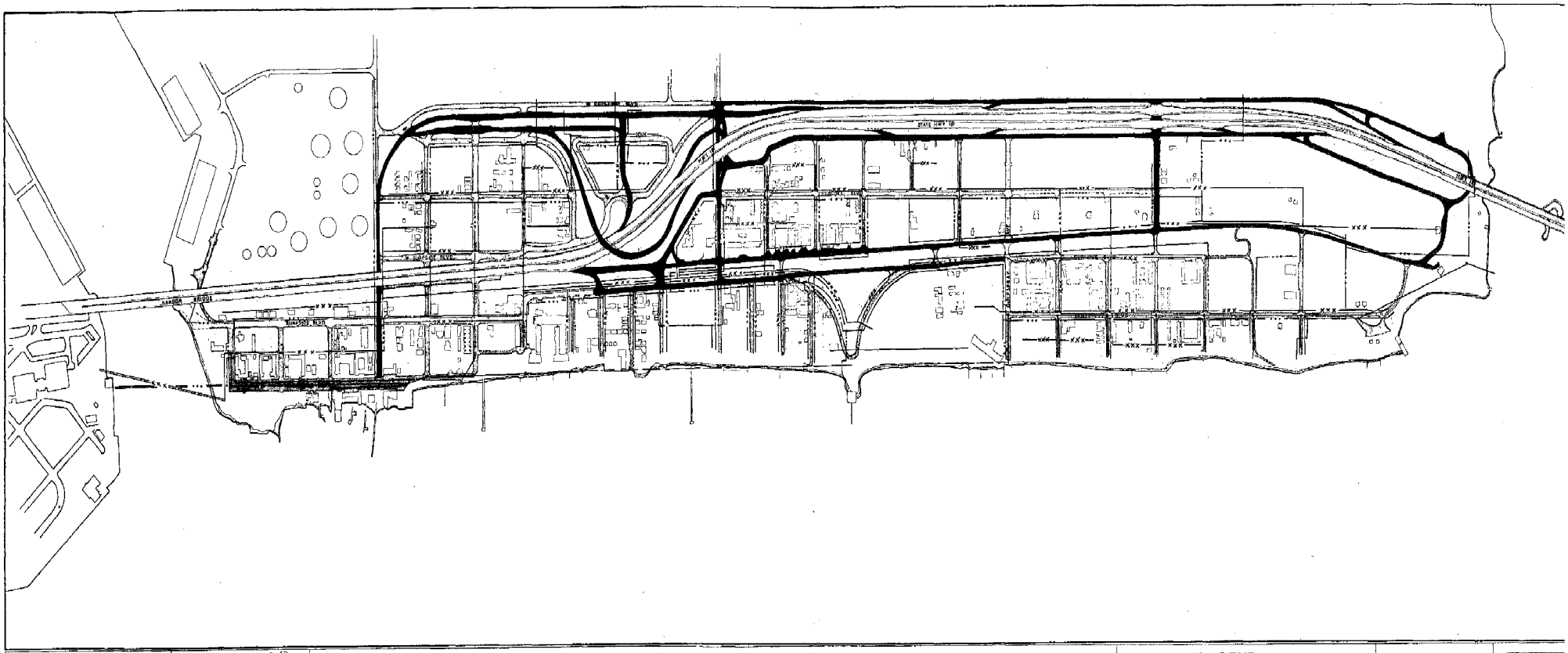
- SINGLE FAMILY RESIDENTIAL
- MULTI FAMILY RESIDENTIAL
- COMMERCIAL
- LIGHT INDUSTRY
- PUBLIC & QUASI-PUBLIC
- UNDEVELOPED

4
SHEET

PLATE 8

EXISTING LAND USE

PLATE 8



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STREETS and UTILITIES

LEGEND

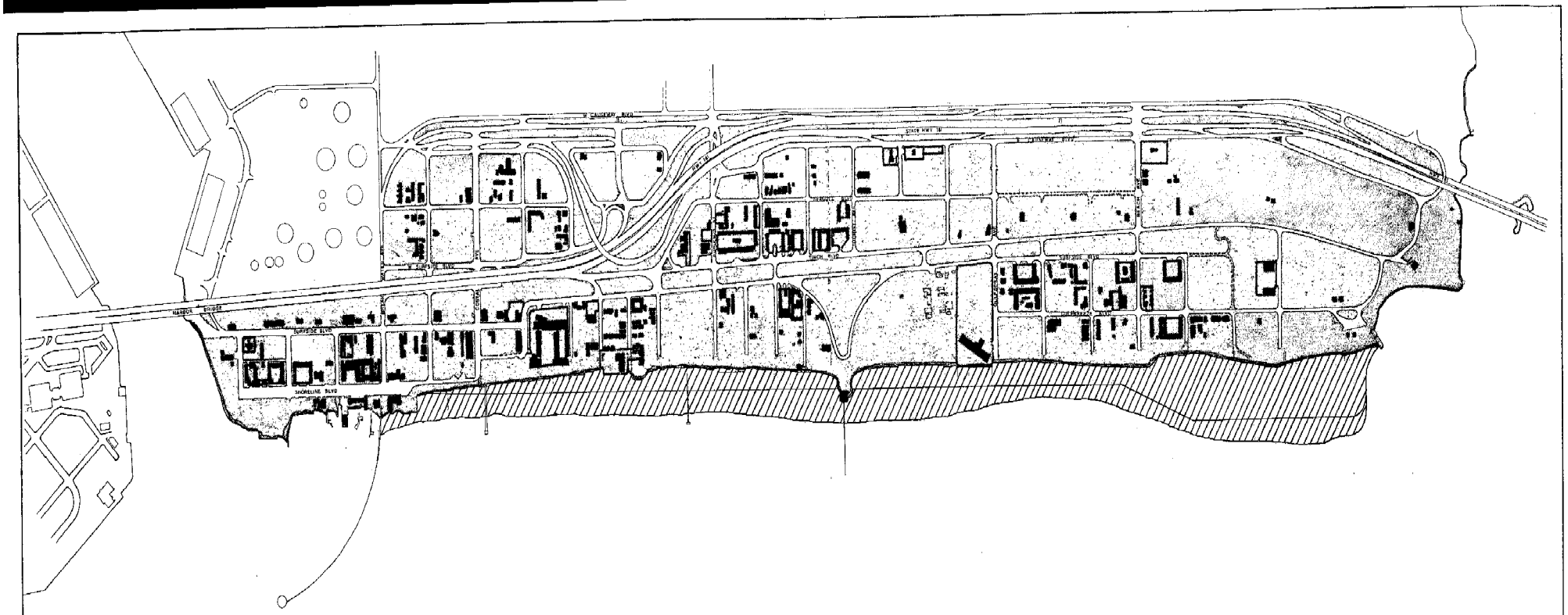
- THOROUGHFARE
- FREEWAY
- OTHER ROADS
- COLLECTORS
- WATER LINE
- SEWAGE LINE
- STORM DRAINAGE

SHEET 5

PLATE 9

STREETS AND UTILITIES

PLATE 9



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UNDER THE SUPERVISION OF DR. W.G. ROESELER, HEAD URPL

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UNDER-USED SPACE

LEGEND

- BUILDING COVERAGE
- UNUSED LAND
- PROPOSED NEW BEACH

7
SHEET

PLATE 9-1

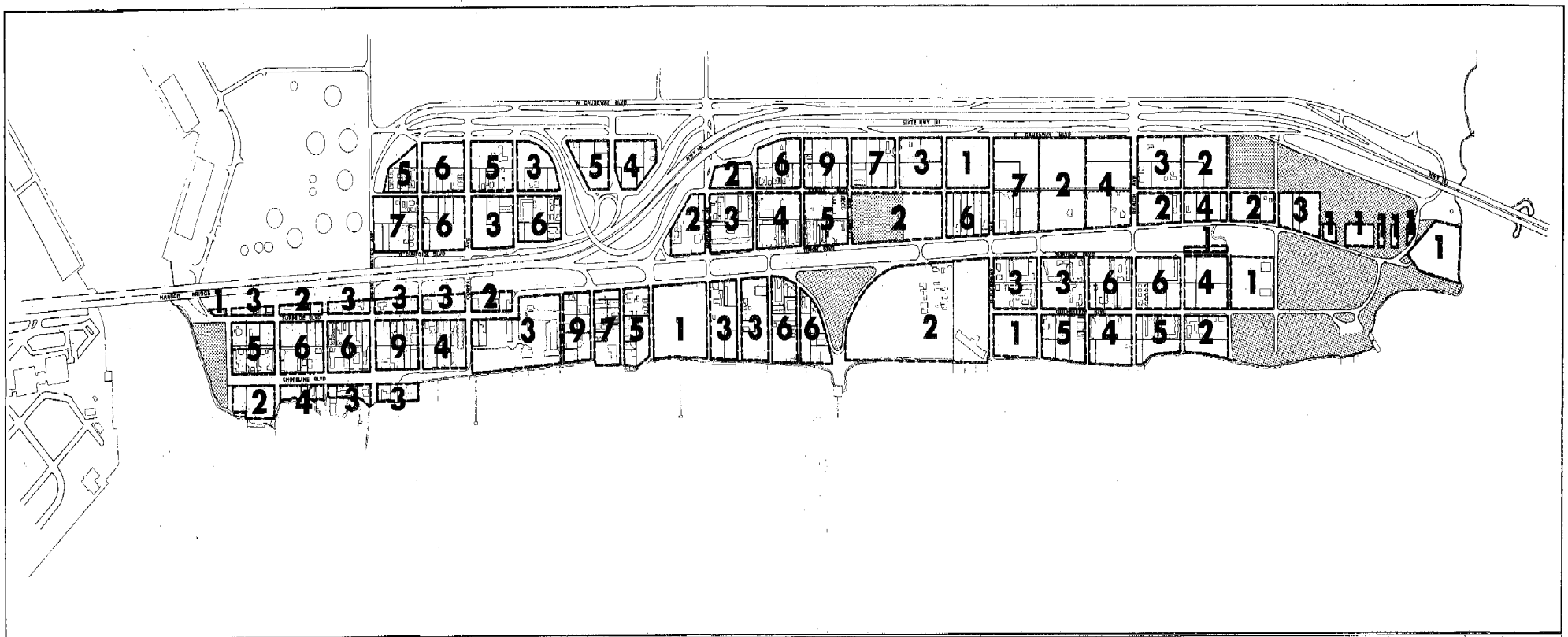
UNDER-USED SPACE

PLATE 9-1

ten-story building, is of considerable interest in this context because it demonstrates that an inaginative developer will immediately make arrangements to work with a modern concept which requires overcoming the antiquated development patterns of the past. The building's orientation is such that maximum exposure is to the Gulf of Mexico and skyline of Corpus Christi, which is obviously the key attraction to living in this area. Likewise, the Master Host Motel is functionally designed and placed in sharp contrast to its surroundings.

Casual examination of courthouse records reveal an obsolete, antiquated lotting pattern which militates against effective reclamation of the land. The tax assessor, though, keeps his eyes on the beach property and will meticulously assess the highest tax values to those properties which enjoy beach access (See Plate 10,10-1). The zoning of this area is superficially oriented toward commercial. However, a broad, loose type of zoning districting tends to produce conflicts and fails to induce sufficiently compatible usage. In many cases, incompatibility has been condoned rather than discouraged as illustrated by location of mobile homes and travel trailers in the immediate vicinity of principal development accomplishments, such as a condominum, (Plate 11). This zoning pattern is in need of a close reevaluation in order to meet the needs of the future, to bring about good investment and to foster conservation.

Taking the natural constraints, the ship channel, the industrial area to the west, the overpowering steel arch bridge, and the causeway, the demand upon the urban designer is substantial. These features are there and cannot be changed. Yet, the area itself, with a new beach presently under construction by the U.S. Army Corps of Engineers, offers outstanding location advantage for active and passive recreation and tourism close to the center of activities of the Corpus Christi metropolitan area. In this sense, it is a unique section and a regional resource which deserves considerable public support and attention. Plate 11 gives some indication of this even under present conditions.



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DEPARTMENT OF URBAN PLANNING TEXAS A&M UNIVERSITY

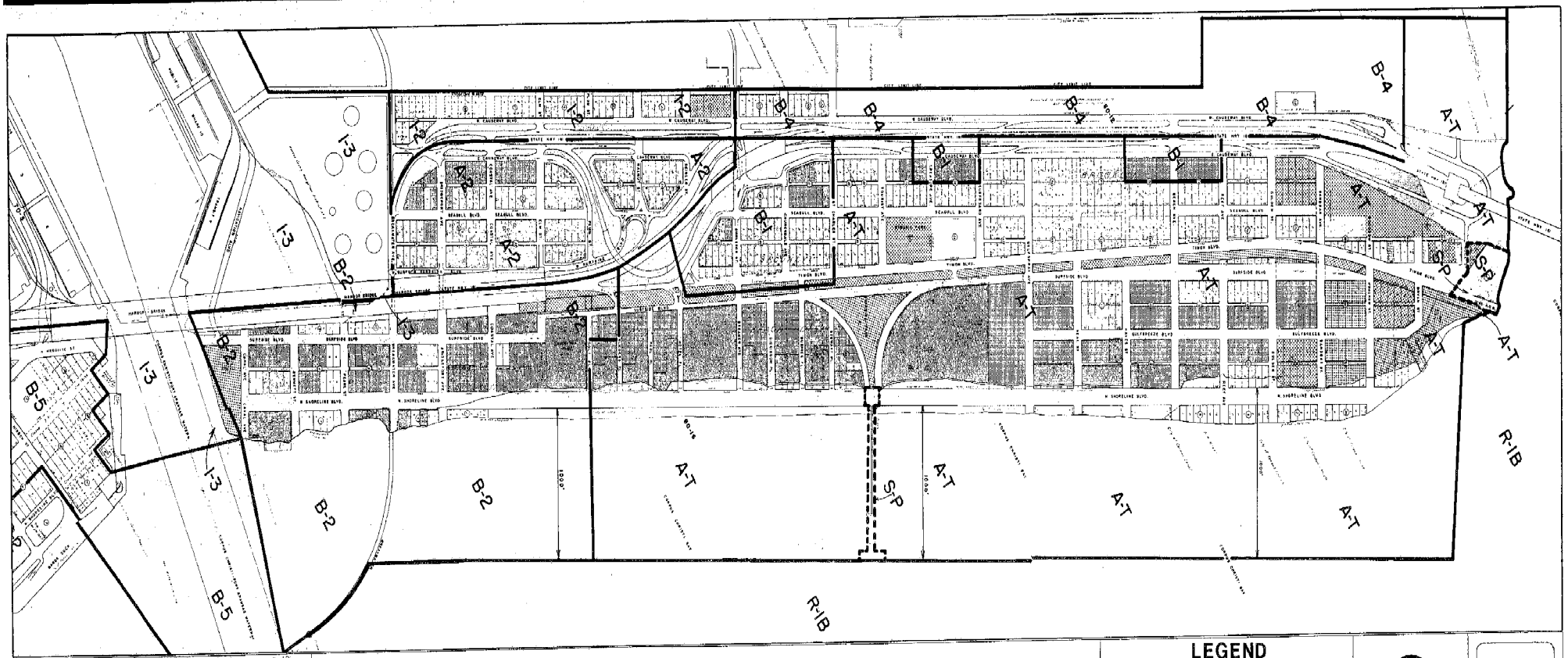
OWNERSHIP CHARACTERISTICS

LEGEND

- BLOCK BOUNDARIES
- LOT BOUNDARIES
- 5 OWNERS PER BLOCK
- PUBLIC LAND

OWNERSHIP CHARACTERISTICS

PLATE 10



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URPL DEPARTMENT OF URBAN PLANNING TEXAS A&M UNIVERSITY

ZONING/LAND VALUE

(ASSESSED EVALUATION OF LAND ONLY)

LEGEND

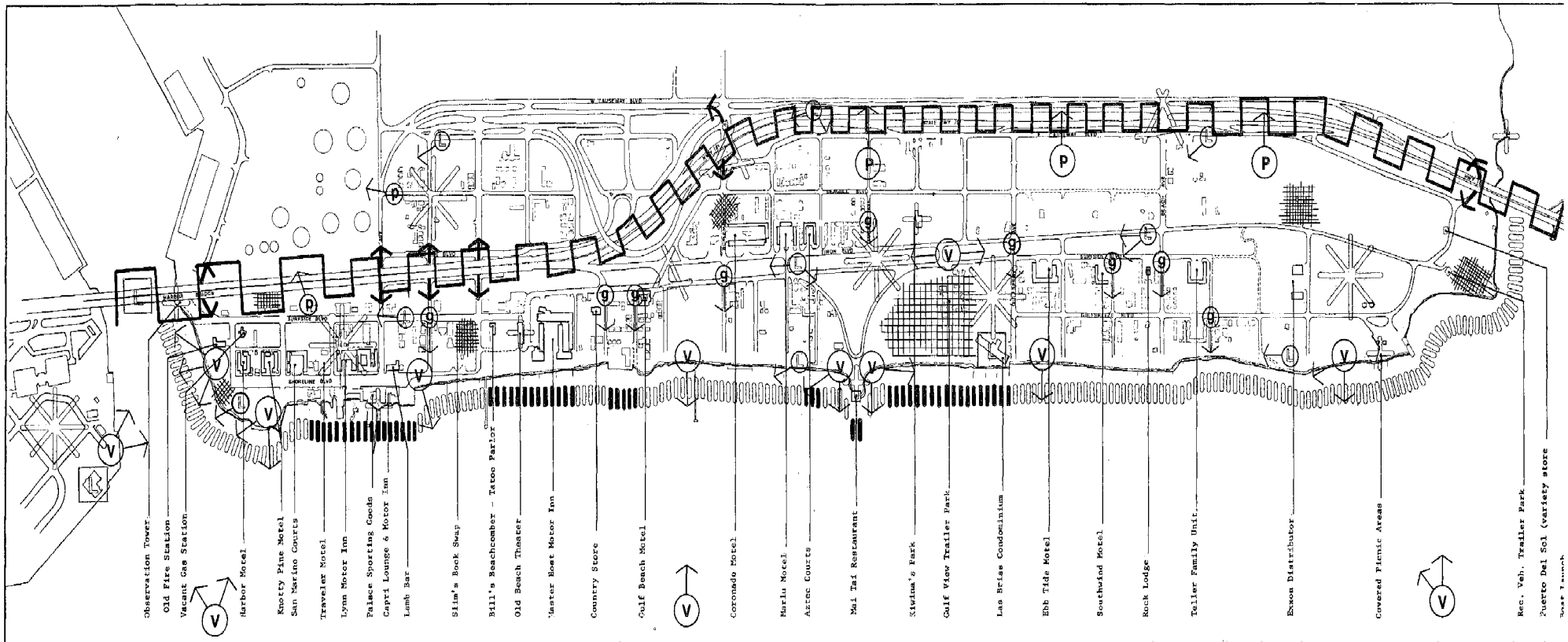
- 0-15¢/sq.ft.
- 16-30¢/sq.ft.
- 31-45¢/sq.ft.
- 46¢ & up/sq.ft.
- City Land

SHEET 6

PLATE 10-1

EXISTING LAND VALUES AND ZONING

PLATE 10-1



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VISUAL ANALYSIS

LEGEND

- (V) Good View
- (L) View of Landmark
- (P) Poor View or Uninteresting
- (g) Glimpse of Beach and Bay
- Visual Landmark
- Barrier (edge) or Constraint
- Predominent Land Use
- Point of Interest
- Vehicular Conflict Points
- Blight Area
- Penetration
- Open & Blocked Public Access

8

SHEE

PLATE

VISUAL ANALYSIS

PLATE 11

GEOLOGY OF THE BEACH

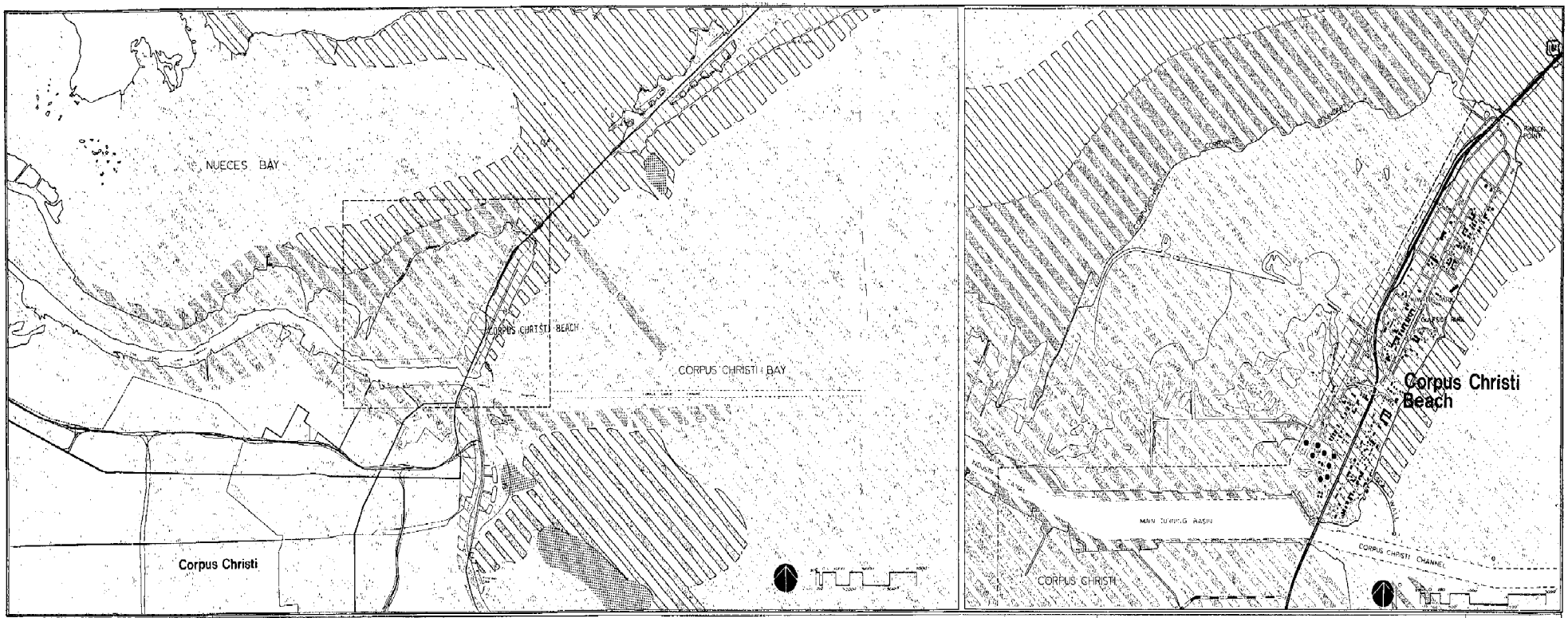
Corpus Christi Beach generally consists of shell and sand, underlain by shelly clay and mud. The grain size changes from sand along the shore zone, to silt in shallow bay water, to fine mud covering the bay bottom. These sediments are the result of geologic processes operating for thousands of years in the Corpus Christi area. During the last period of continental glaciation, 30,000 years ago, sea level was as much as 400 feet lower than present. Deep river valleys formed in the areas of Aransas, Mission and Nueces Bays. As sea level rose to its present elevation, large quantities of sand, silt and mud filled these deep valleys. The sediments were then redistributed around the bays, and adjacent areas, by geologic processes still operating today. The major geologic forces are portrayed by Plates 12 and 13.

Sedimentation and Erosion

The shoreline of Corpus Christi Beach has experienced erosion since 1880. This erosion is attributed to natural processes of wave attack and longshore currents on the beach, and to some degree, man's removal of beach material. Natural processes may act over long time periods at predictable magnitudes and durations, or as violent, short-term unpredictable events.

Long-term processes derive their energy primarily from the wind. The two dominant wind regimes in the area are the persistent southeasterly winds of the warm months, and the strong northerly winds of the winter (Plate 13).

Sediment is naturally supplied to Corpus Christi Beach by onshore waves and longshore currents. The southeast winds produce waves acting normal to the shore which set up northeast and southwest longshore currents along the beach. During the winter months, storm winds are primarily responsible for creating southwest longshore currents sweeping the shoreline. Bay bottom sand and shell is supplied to the beach by waves which transport this material onshore. Longshore currents move sand from the bluffs surrounding Corpus Christi Bay both southward and northward to the Corpus Christi shoreline. Over a period of years, southward moving currents are dominant over those moving north along the beach, shown by the hooked shore of the north end of Corpus Christi Beach, as opposed to the straight shoreline



CORPUS CHRISTI BEACH
DEVELOPMENT GUIDE PLAN

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- W.J.SCHULTZ-URBAN PLANNING - RESEARCH ASSISTANT
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UNDER THE SUPERVISION OF DR W.G. ROESELER, HEAD URPL

URPL DEPARTMENT OF URBAN PLANNING TEXAS A&M UNIVERSITY

GENERALIZED GEOLOGY

LEGEND

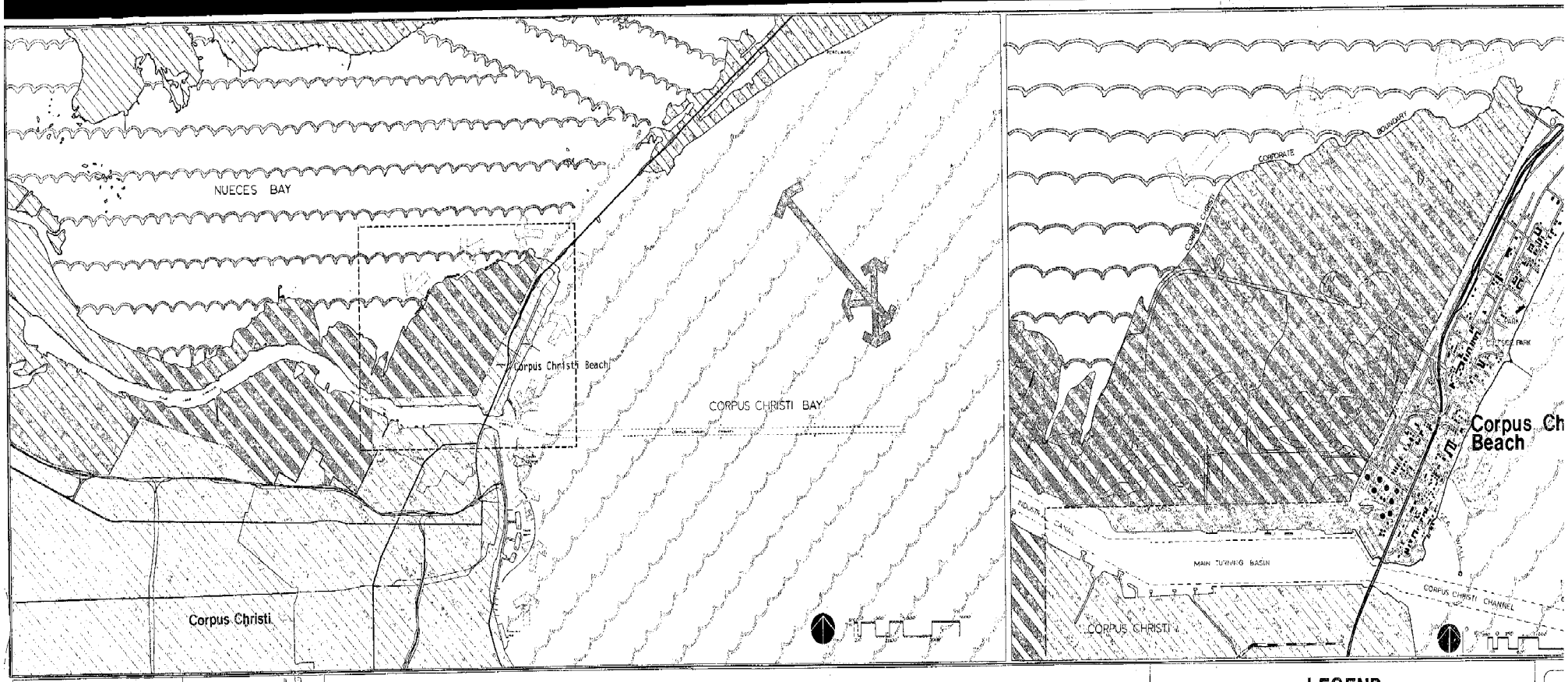
- ALLUVIAL PLAIN DEPOSIT
- MAN-MADE LAND
- BEACH SAND
- SPOIL (UNDERWATER)
- BAY BOTTOM MUD
- Bay Bottom Sand
- OYSTER SHELL REEF (UNDERWATER)

1
SHEET

PLATE 12

GENERALIZED GEOLOGY

PLATE 12



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DEVELOPMENT GUIDE PLAN

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WIND, WAVES & CURRENTS

LEGEND

- CITY
- EXTRATERRITORIAL JURISDICTION
- SUMMER WAVES
- WINTERWAVES
- INUNDATION BY BEULAH
- LONGSHORE CURRENT
- WIND STRENGTH AND DIRECTION

WINDS, WAVES AND CURRENTS

PLATE 13

at Portland (Plate 13).

Several factors have contributed to the natural long-term erosion of the beach, either by limiting the transporting capabilities of the natural processes or reducing the sediment available for transport. Wave energy is reduced in Corpus Christi Bay by the shallowing of the bay itself and by the spoil bank dam of the ship channel. These conditions limit the wave height, which in turn decreases the energy necessary to supply sediment to the beach. Sediment available for transport to the beach has been reduced in several ways. Siltation of the bay has deposited a layer of mud over sand and shell on the bay bottom. This mud has the effect of protecting the underlying material from transport as well as killing shelled animals. The naturally formed sediments from living shellfish also serve as beach material. Structures within and around the bay have also reduced the sediment supply by obstructing its passage to the beach. The spoil bank dam of the ship channel, the curvilinear breakwater at Corpus Christi Beach, and bridge pilings across Nueces Bay retard and trap sediment. Urban development along the Corpus Christi Bay shoreline restricts sediment and limits the amount of sand discharged into the Bay through ravines at Corpus Christi and Portland and protective sodding and buildings reduce the sediment supplied to the bay be decreasing surface erosion.

Natural long-term erosion occurs when storm waves attack the beach, carrying material offshore, and

when southwest moving longshore currents deprived of sediment load erode beach material suspended by wave action. Artificial erosion has occured by the actual removal of sand and shell from the beach by shell contractors since 1919. From recent observation, sand removal practices are still being continued on a small scale.

Short-term processes have contributed heavily to the erosion of Corpus Christi Beach. Severe storms and hurricanes produce large waves which scour the shoreline and carry material offshore. The 1919 hurricane, in particular, caused extensive erosion. More recently, hurricanes striking the Corpus Christi area (Carla in 1961, Beulah in 1967, and Celia in 1970) have also caused shoreline erosion.

Geologically, the formation of Corpus Christi Beach required sedimentation to exceed erosion of the shoreline. The beach is presently eroding because the amount of sediment supplied to the beach has been decreased, both naturally and through man's intervention, while the forces causing erosion have remained the same.

Storms

Two principal wind regimes dominate the Texas coast and Corpus Christi -- persistent, southeasterly winds from March through September and north-northeasterly winds from October through February (Behrens and Watson, 1973).

Hurricanes are severe tropical storms that accelerate coastal processes so that during the few hours of passage, the coastal systems experience a degree of erosion and deposition equal to months or years at the normal level of coastal activity. Most hurricanes strike the coast from the southeast, although they may veer along the coast, striking it at any angle. Hurricanes become a more serious problem each year, because of expanding population, industry, and development along the Texas coast. These high-energy storms have a significant effect on certain coastal environments that are already overstressed by intensive use.

Hurricanes vary in intensity and size, but several factors effects the severity of their impact upon the coast:

(1) bottom slope and profile of the inner shelf and shoreface;

(2) position and degree of the astronomical tide cycle at the time of approach;

(3) shape and orientation of barrier islands or deltaic headlands, as well as passes and upper bay area;

(4) degree of vegetative zones in the area of impact; and

(5) angle at which the storm cell strikes the coastline.

These factors determine how much of the storm-tidal range will be dissipated upon striking land and how much energy will remain to inflict damage. Principal devastating hurricanes impacting Texas are shown on Plate 14.

Hurricane Carla (September 8, 1961) hit Port O'Connor with maximum wind gusts at Port Lavaca estimated at 175 miles per hour. The highest tide was 18.5 feet at Port Lavaca. Most of the damage was to the coastal counties between Corpus Christi and Port Arthur and inland to Jackson, Harris and Wharton Counties. In Texas, 34 persons dies; 7 in a tornado that swept across Galveston island; 465 persons were injured. Property and crop damage are conservatively estimated at $300,000,000. Hurricane Carla was the largest hurricane on record.

Hurricane Beulah (September 18-23, 1967), the third largest hurricane on record, moved inland near the mouth of the Rio Grande on the 20th. Wind gusts of 136 miles per hour were reported during Beulah's passage. Rainfall 10 to 20 inches over much of the area south of San Antonio, resulted in record-breaking floods. Beulah spawned 115 tornadoes, all in Texas, the greatest number on record for any hurricane. Beulah caused 13 deaths and 37 injuries, of which 5 deaths and 34 injuries were attributed to tornadoes. Property losses were estimated at $100 million and crop losses at $50 million.

HURRICANES

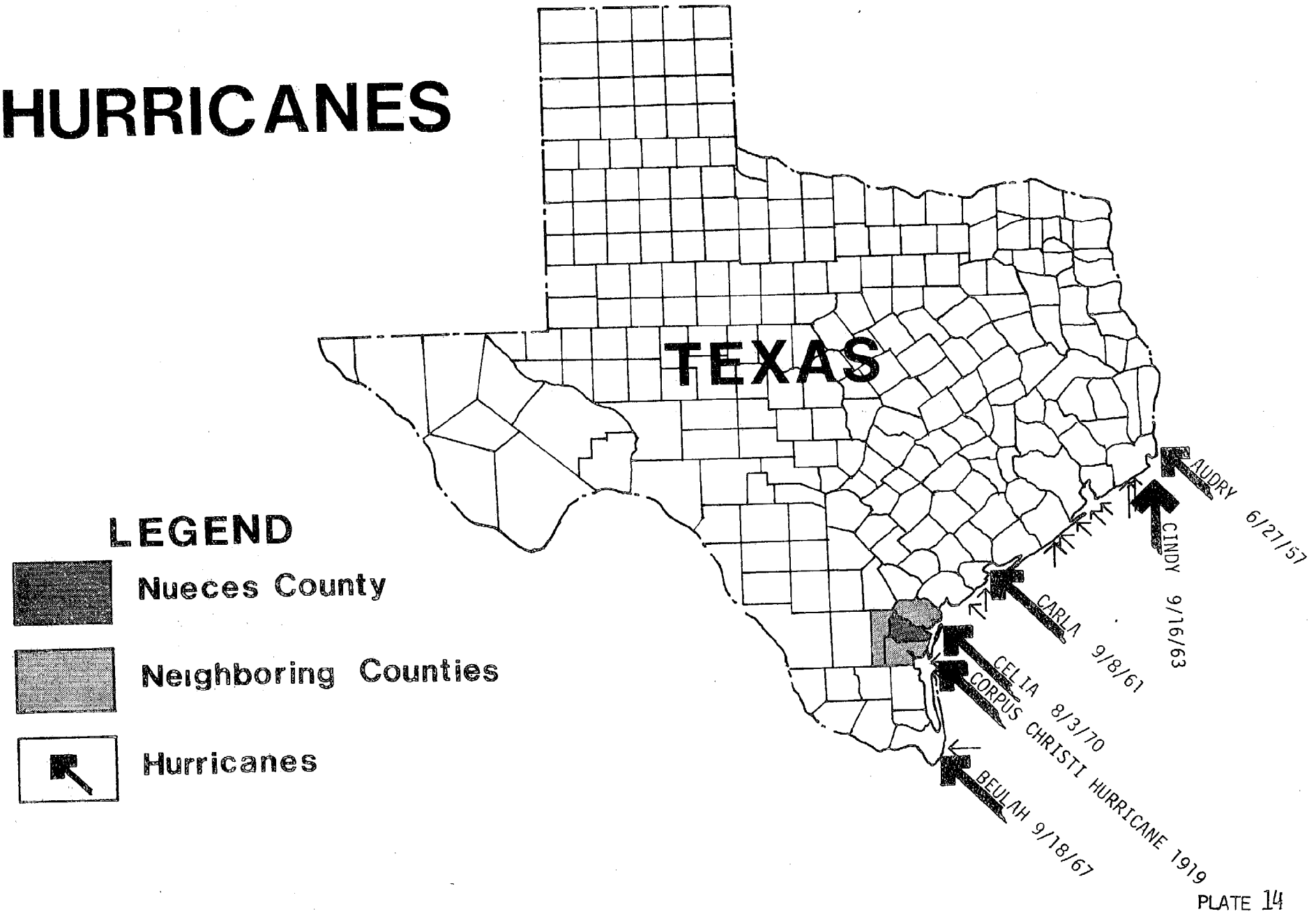


PLATE 14

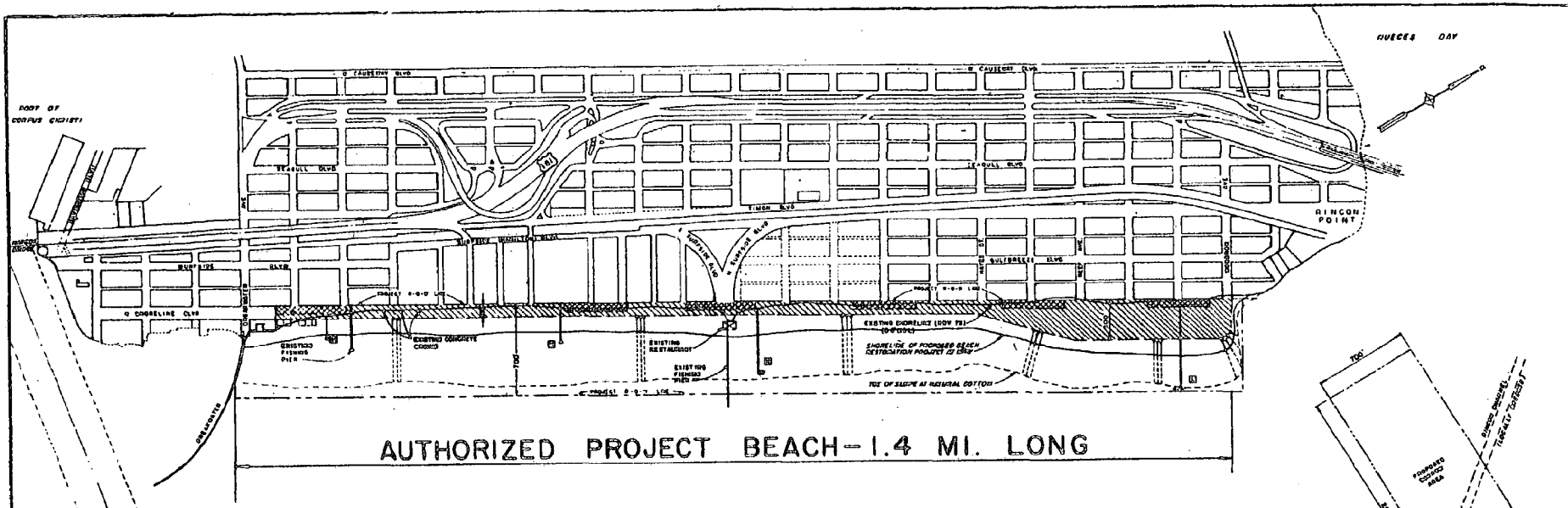
On August 3-5, 1970, hurricane Celia hit Corpus Christi. This was a unique, but severe storm. Measured in dollars, it was the costliest in the state's history. Substained wind speeds reached 130 miles per hour, but it was a great burst of kinetic energy of short duration that appeared to cause the severe damage. Wind gusts of 161 miles per hour were measured at Corpus Christi National Weather Service offices. At Aransas Pass, peak wind gusts were estimated as high as 180 miles per hour after the wind equipment had been blown away. Celia caused 11 deaths in Texas, at least 466 injuries, and total property and crop damage in Texas estimated $453,733,000. Hurricane Celia crossed the Texas Coastline mid-way between Corpus Christi and Aransas Pass about 3:30 CST on August 3. The hardest hit was the metropolitan area of Corpus Christi, including Robstown, Aransas Pass, Port Aransas, and small towns on the north side of Corpus Christi Bay.

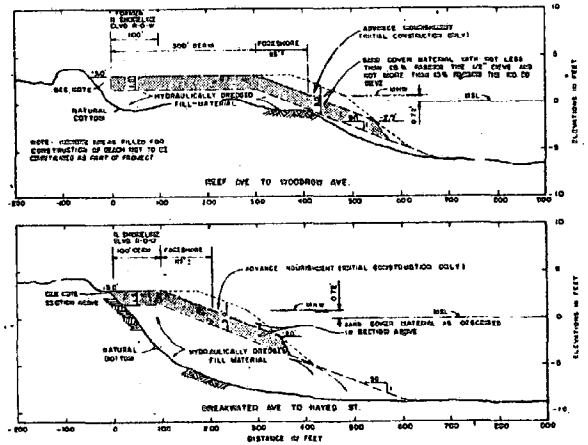
Of particular importance to Corpus Christi Beach, however, was the 1919 hurricane known as the Corpus Christi Storm. It destroyed the then prosperous resort area of Corpus Christi Beach, a disaster from which the area never recovered. Hotels, a salt water pool, residences and other property became victims of the hurricane together with the permanent loss of part of the street system and the beaches. Some 300 Texans died in the storm which produced 110 mile per hour winds in Corpus Christi and tides 16 feet above normal. The damage was estimated to be $20 million in 1919 values.

Restoration and Maintenance

Because of the continual process or erosion of Corpus Christi Beach, restoration of the Beach accompanied by periodic nourishment is required in order to develop the economic and recreational potential of the area. The restoration project has already begun under the direction of the U.S. Army Corps of Engineers.

The method of restoration selected by the U.S. Corps of Engineers is similar to that suggested by Price (1956). This consists of rebuilding the beach with sand, and replenishing the beach as it erodes. As stated in the Corps of Engineers report (1975), the restoration provides an improved beach with "a berm width of 100 feet along the 5,350 feet reach between Breakwater Avenue and Hays Street", (Plate 15), "thence increasing uniformly to a width of 300 feet along the 700 feet distance to Reef Avenue, and continuing 300 feet wide to Woodrow Avenue, an overall length of 7,200 feet." The berm crest elevation will be plus 3 feet, with a total dry beach of approximately 1,800,000 square feet. Construction of the beach will be in two stages. First, 535,000 cubic years of fill, consisting of fine sand and silty sand dredged from nearby borrow areas will be deposited along the beach, and mechanically shaped. Sand will then be transported to the beach area by barge from inland sources, and unloaded into haul units, to be distributed along the beach. The sand cover material will be 1.5 feet thick on the level berm and 3 feet thick at the face of the bayward slope, allowing 1.5 feet on the





TYPICAL SECTIONS
(LOOKING NORTHERLY)

LEGEND

AUTHORIZED 100' TO 300' WIDE BEACH WITH TOP ELEVATION OF +5.0 MSL

60' WIDE BY 450' TO 500' LONG PARKING AREAS BY LOCAL INTERESTS.

SLOPE 50 : 1 ON 50 FROM CREST TO NATURAL BAY COTTOM

STORM DAMAGED PIERS TO BE REMOVED OR REBUILT AT LOCAL EXPENSE AS NON-PROJECT ITEMS, BUT SUBJECT TO LOCAL COOPERATION REQUIREMENTS FOR ADMINISTRATION.

CORPUS CHRISTI BEACH, TEXAS
(RESTORATION PROJECT)
AUTHORIZED
PLAN OF IMPROVEMENT
SCALE IN FEET
100 0 500 1000

U.S. ARMY ENGINEER DISTRICT, GALVESTON, TEXAS — 1975

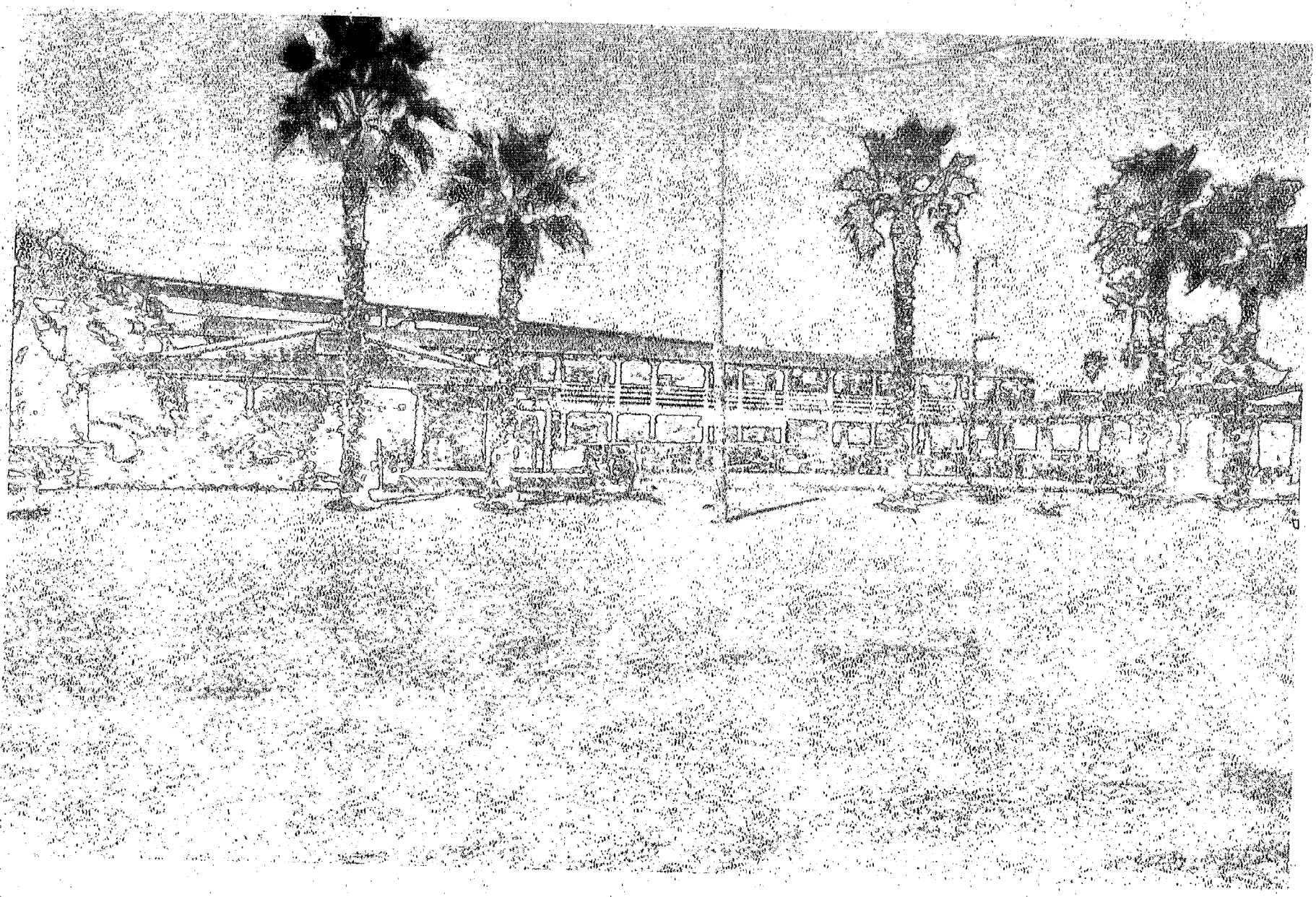
TO ACCOMPANY GENERAL DESIGN MEMORANDUM
PHASE I — PROJECT FORMULATION

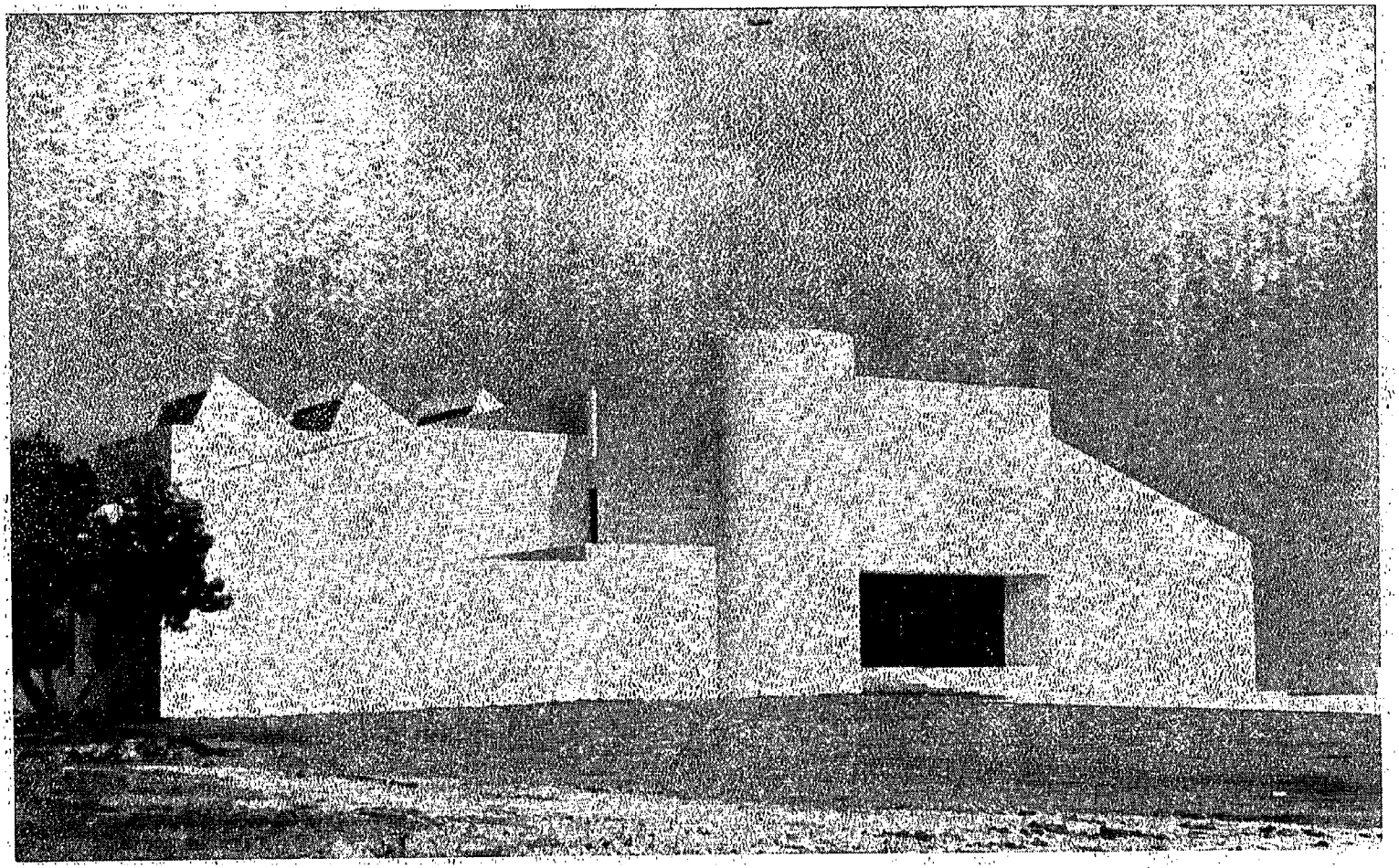
Corpus Christi Beach Project: U.S. Army Corp Engineers

PLATE 15

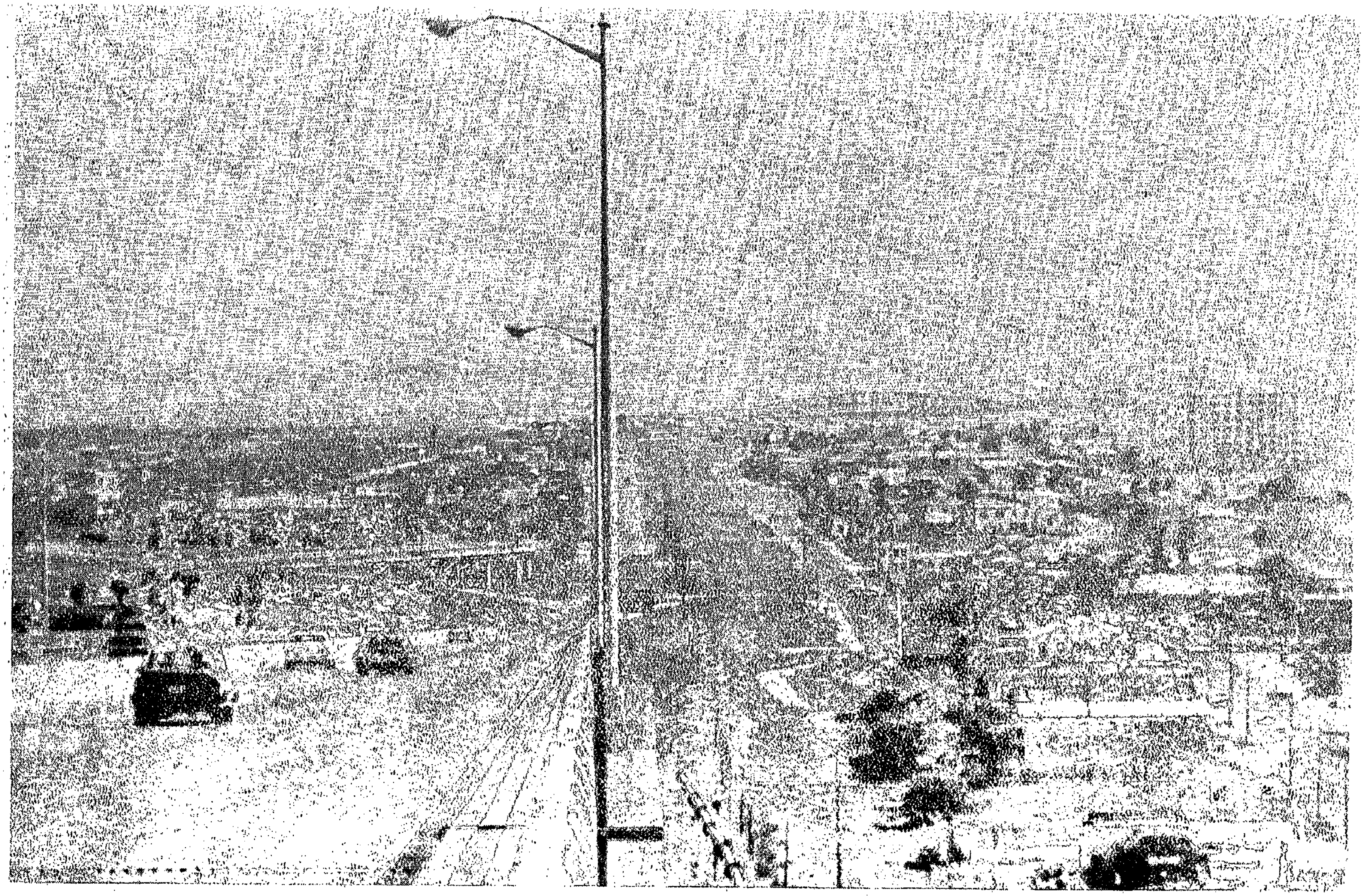
slope for a 5 year advance nourishment. The slope of the beach will be 1 foot vertical to 50 feet horizontal.

Erosion of the new beach will occur by storm wave attack moving material offshore, and longshore sediment transport moving material to the southwest. In the case of the former, by constructing the beach with a wide berm width and gentle slope, the force of these storm waves will be reduced. Thus, larger storm waves would now be necessary to erode the new beach. It is estimated that the effects of wave attack and longshore currents will result in an average annual loss of 25,000 cubic yards from the beach and foreshore. However, depending upon the intensity and frequency of storms this loss will vary. The Federal government will provide the first 10 years of nourishment with a 50% contribution from local interests, afterwhich maintenance of the beach will be entirely a local responsibility.





Design



DESIGN OBJECTIVES AND CONCEPTS

The natural assets of Corpus Christi Beach, such as the beach itself, beach oriented activities, pleasant temperatures and close proximity to the center of the metropolitan area, would be most complimented by the development of waterfront housing and recreational facilities. Furthermore, the relatively short distance to the waterfront from any location within the study area should provide ever increasing incentives for investment, for it is established that man strives to be close to water.

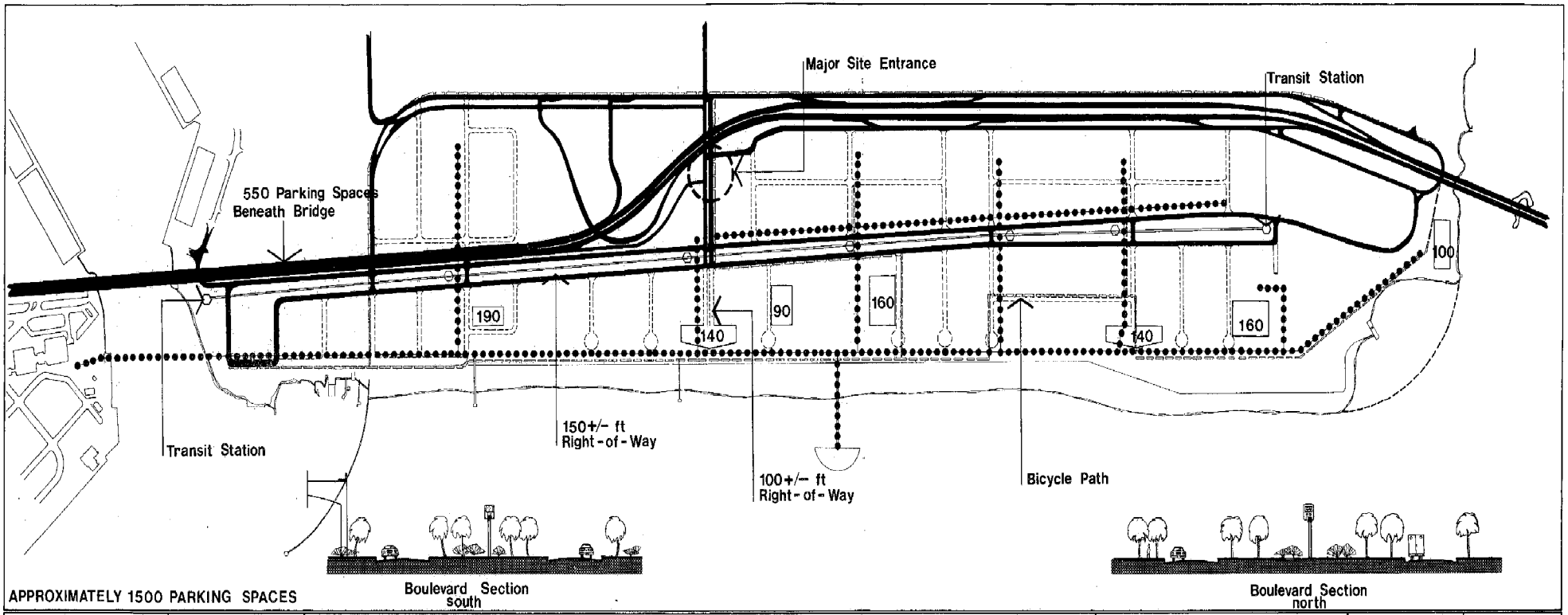
Linkages

Coinciding with these design objectives, it was agreed that the present system of streets and walkways need modification, so as to improve accessibility, functional separation of land uses and to take advantage of aesthetic features, Plate 16. Corpus Christi has gained recognition for Ocean Drive, a wide boulevard landscaped with subtropical plant material. Therefore, it would seem natural to continue the same theme in this area, where it once existed. For this reason, Timon and Surfside Boulevards are molded into a distinctive feature, extending from North Channel Park to Rincon Park. This primary boulevard, carefully designed and landscaped with subtropical plants, has an average right-of-way of 150 feet. It could become a major attraction. This generous allocation of land seems to be fully justified, because of the fact that this boulevard will induce substantially higher investments than an ordinary street frontage

to offset tax losses. West Palm Beach, Miami, Clearwater, Florida - among other coastal cities - amply demonstrate the validity of this concept.

Perhaps at some point in time, it may be advantageous to provide a personal rapid transit system (PRT) for residents and tourists along the boulevard which could be utilized as feature attraction. The PRT might be an elevated, small vehicle, perhaps a monorail, similar to those in Miami Beach. Traveling above the palm trees between North Channel Park and Rincon Park would certainly generate excitement. The system would best be located within the median of Timon and Surfside Boulevards, which would provide maximum access and the most direct and unobstructed path of travel.

Walkways are essential to the vitality of the beach. Access should be strictly limited to pedestrians, while at the same time providing a means of evenly distributing beach users. These walkways, in the immediate vicinity of the beach, will also accommodate necessary beach support facilities, such as bathhouses, restrooms and concession stands. An attractive environment would be created with wide (15 to 20 foot), well designed walkways, having such features as resting or sitting areas, grade-level changes, dynamic landscaping, fountains and an exciting view of the Gulf. The walks could be complimented by a system of bikeways clearly separated from the walkways and roadways.



APPROXIMATELY 1500 PARKING SPACES

CORPUS CHRISTI BEACH
DEVELOPMENT GUIDE PLAN

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- C.A. HARDING - URBAN PLANNING
- T. WATSON - GEOLOGY

UNDER THE SUPERVISION OF PROF. W.G. ROESELER, DEPT. HEAD URPL

URPL DEPARTMENT OF URBAN PLANNING TEXAS A&M UNIVERSITY

CIRCULATION PLAN

LEGEND

- ARTERIAL STREETS [90] NO. OF PARKING SPACES
- MINOR ACCESS STREETS (TO BE ESTABLISHED OR CONDITIONAL IF NEEDED)

19
SHEET

PLATE 16

CIRCULATION PLAN

PLATE 16

To achieve the design objectives and to foster the general waterfront atmosphere allowing for constant visual and physical links with the water, a series of parks and open spaces are needed, Plate 17. As an open space, the beach is a natural and attractive environment, running nearly the full length of the study area. The beach itself provides an attractive connection between Rincon, Surfside and North Channel Parks, and relief of possible wall-like (Plates 18-1 through 18-4) building development which could occur behind the beach right-of-way.

Rincon Park

A large saltwater swimming pool could be incorporated into the eroded beach at Rincon Park in order to alleviate the problems inherent to swimming along the churning Texas coast. The murky water, the dangerous jellyfish and seaweed are not inducive to swimming. To overcome the problem a saltwater pool is proposed using techniques not uncommon along Spain's rocky Mediterranean coast. The 9-acre saltwater pool, enclosed by two wide beaches, would be the major attraction at the park. The arc-shaped seawall should deter continuing erosion and provide a clean, clear and attractive swimming environment. This saltwater pool would be the major attraction, in conjunction with additional recreational facilities such as picnic areas, boating, fishing, sunbathing and outdoor sports. Tourist and community facilities should also be located here, as a maximum access is available through transit stops, automobile parking, pedestrian walkways and bicycle paths. As noted, a saltwater swimming pool existed here many years ago.

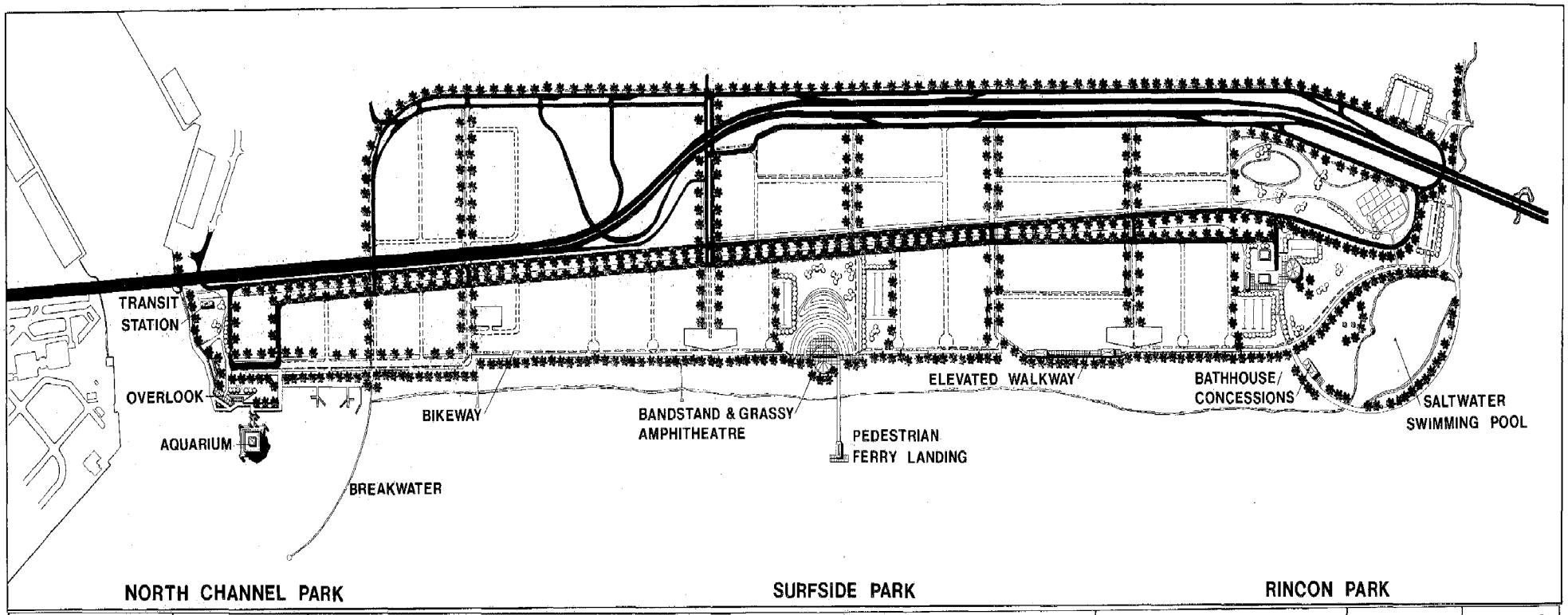
Another alternative for Rincon Park would be an aquarium complex nestled on islands and connected to the peninsula by pedestrian bridges. Facilities at the aquarium would include tanks, concession areas, gift shops, a water show and a scenic overlook. All of these structures would be set within tropical landscaping. A combination of the aquarium and the saltwater pool could also be a consideration. Rincon Park would facilitate yet other activities such as tennis and miniature golf.

Surfside Park

Surfside Park, located near the center of the Beach, would provide a transition between high and moderate density and variations in height and bulk. It would provide a beautiful park for passive recreation. It would be connected to Rincon Park by an elevated walkway, in scale with the high rise buildings proposed to be concentrated between Rincon and Surfside Parks. A bandstand with a grassy amphitheatre would serve as a focal point for the park, whose other facilities would include concession stands and picnicing areas. A pedestrian ferry landing would be an additional feature for persons commuting from the city's convention center south of the ship channel.

A Third Open Space (Plates 19-1 and 19-2)

A third park, adjacent to the ship channel, will provide an excellent opportunity for a transitional and also passive environment. This will anchor Corpus Christi Beach on its south end with a



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UNDER THE SUPERVISION OF DR. W.B. HOESEN, DEPT. HEAD UPL

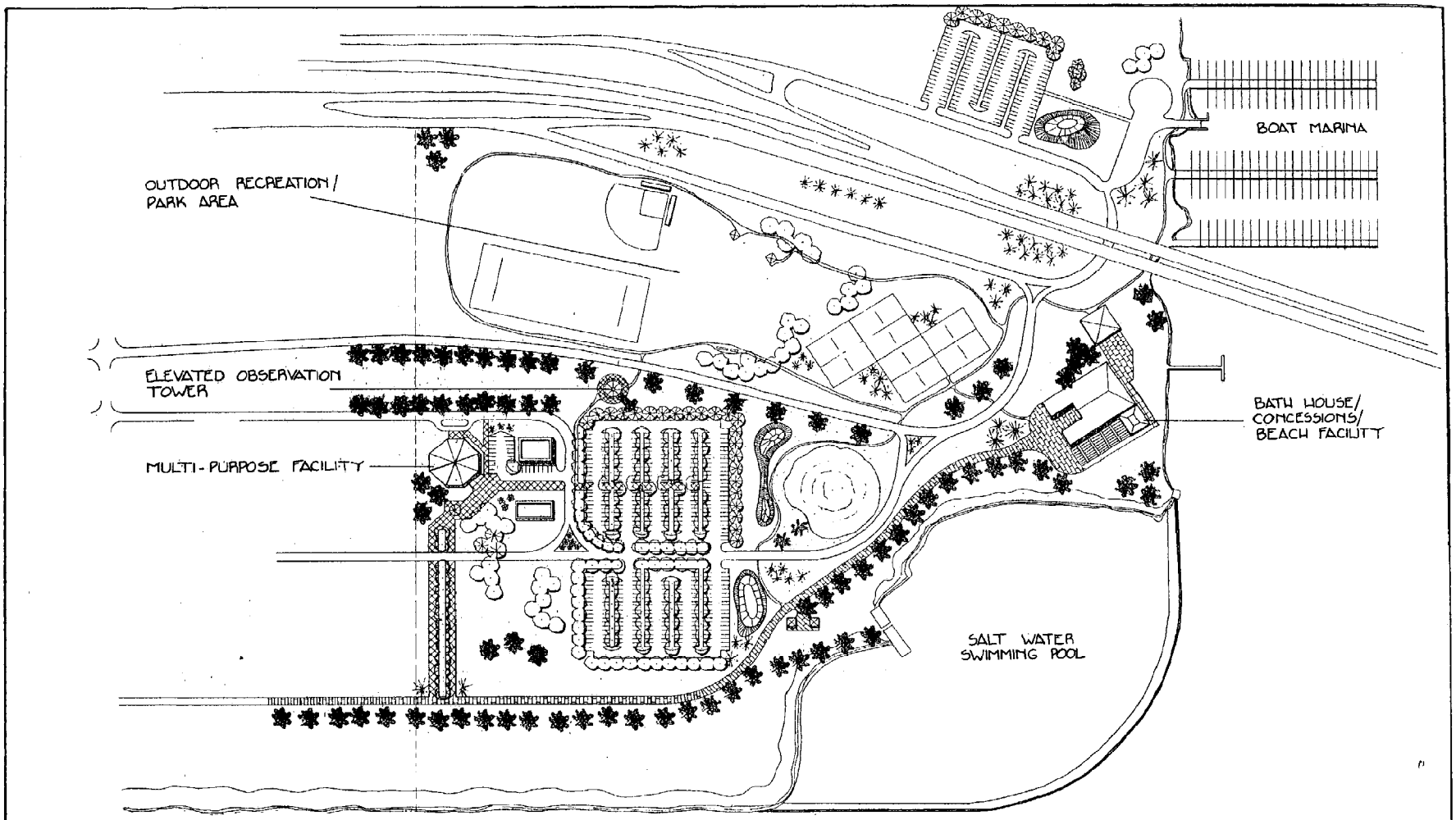
UPL DEPARTMENT OF URBAN PLANNING TEXAS A&M UNIVERSITY

OPEN SPACE PLAN

17
SHEET
PLATE 17

OPEN SPACE PLAN

PLATE 17



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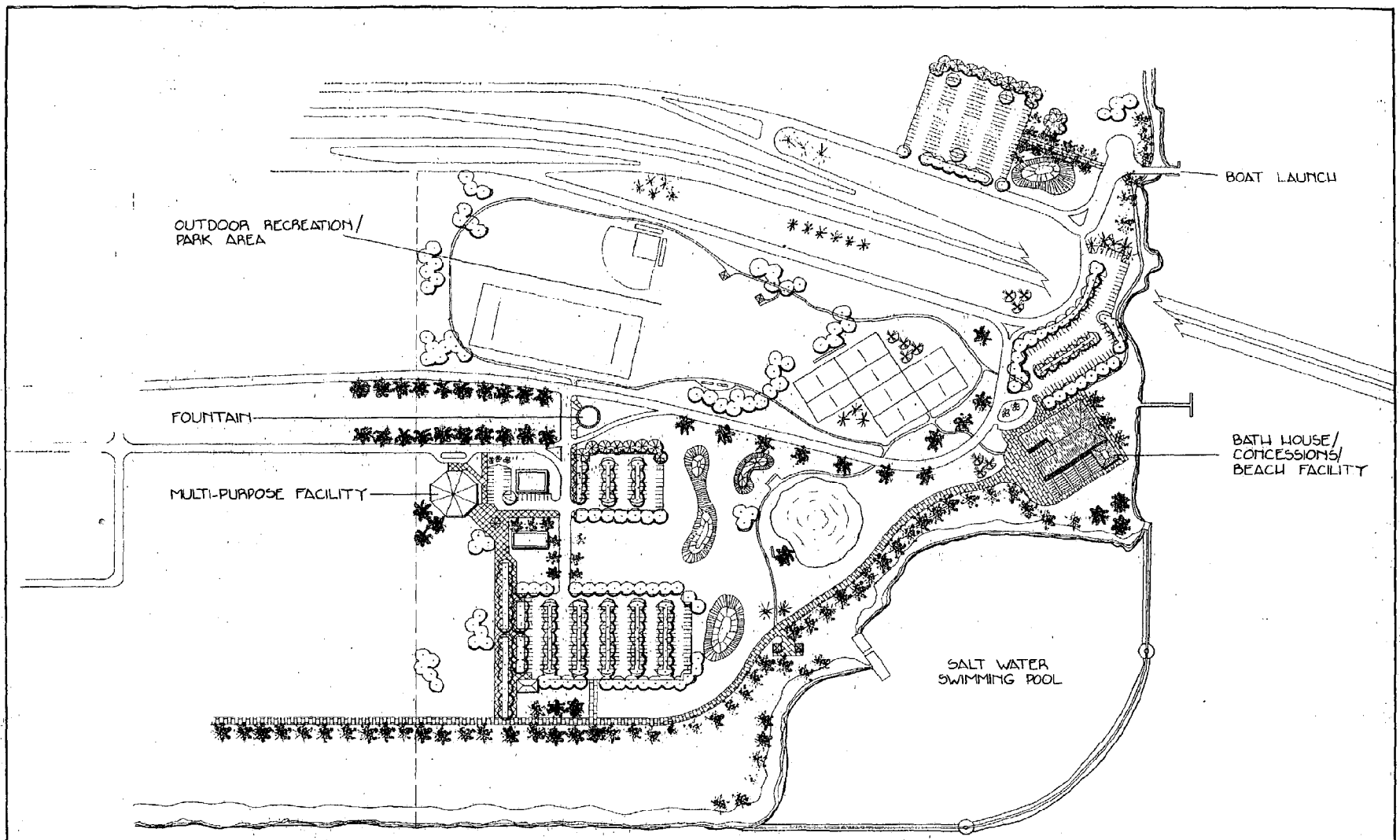
RINCON PARK CONCEPT A

11 SHEET

PLATE 18-1



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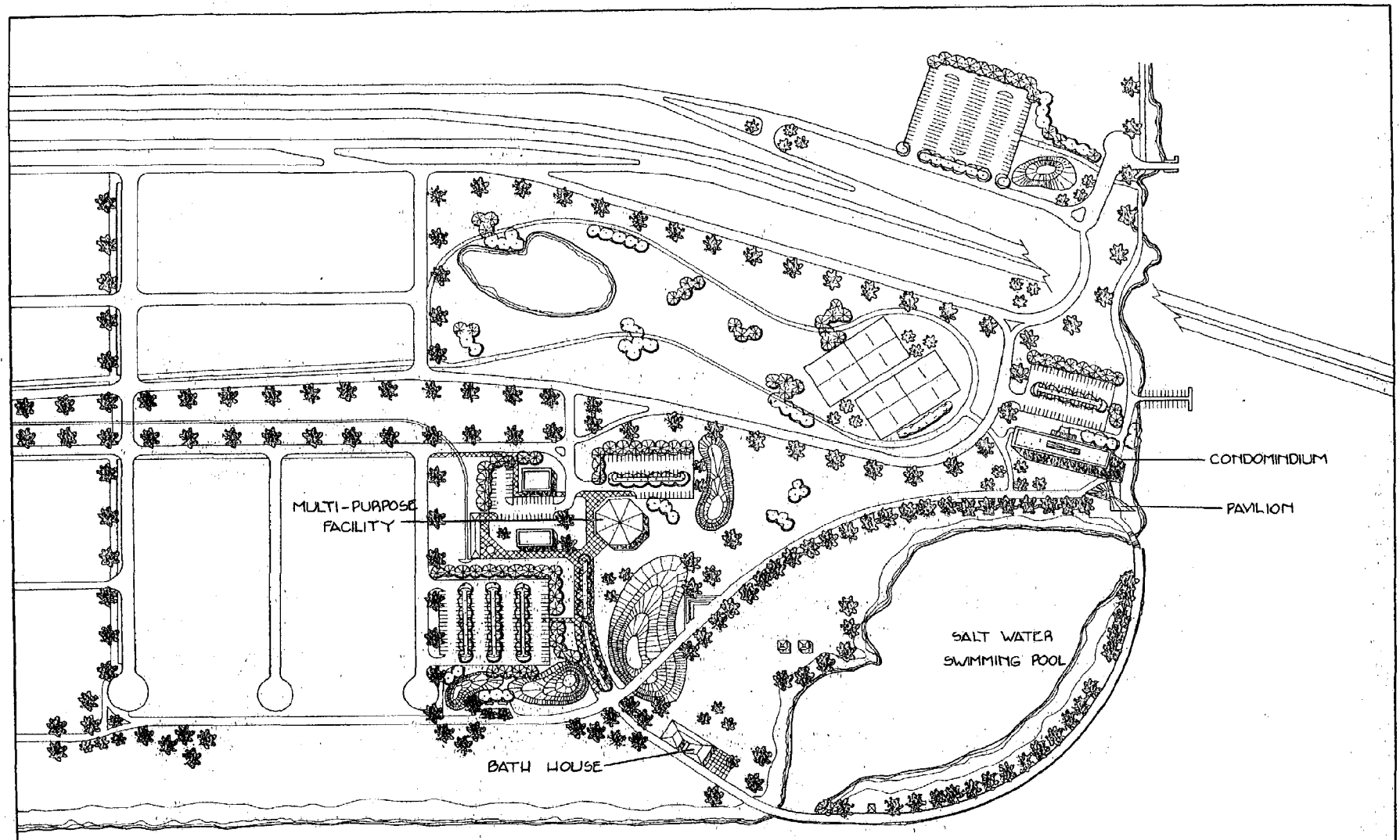
RINCON PARK CONCEPT B

12
SHEET

PLATE 18-2



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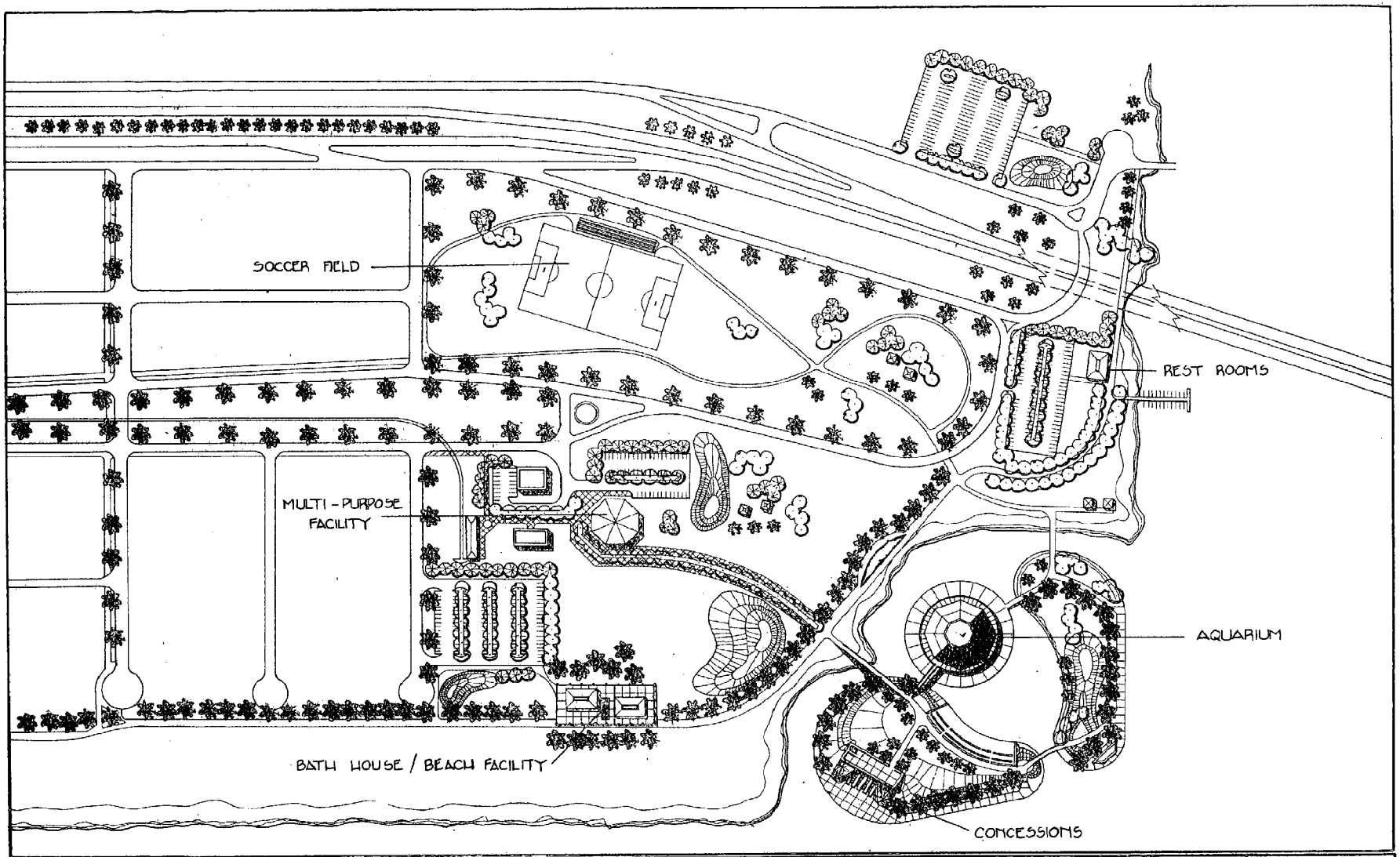
RINCON PARK CONCEPT C

13 SHEET

PLATE 18-3



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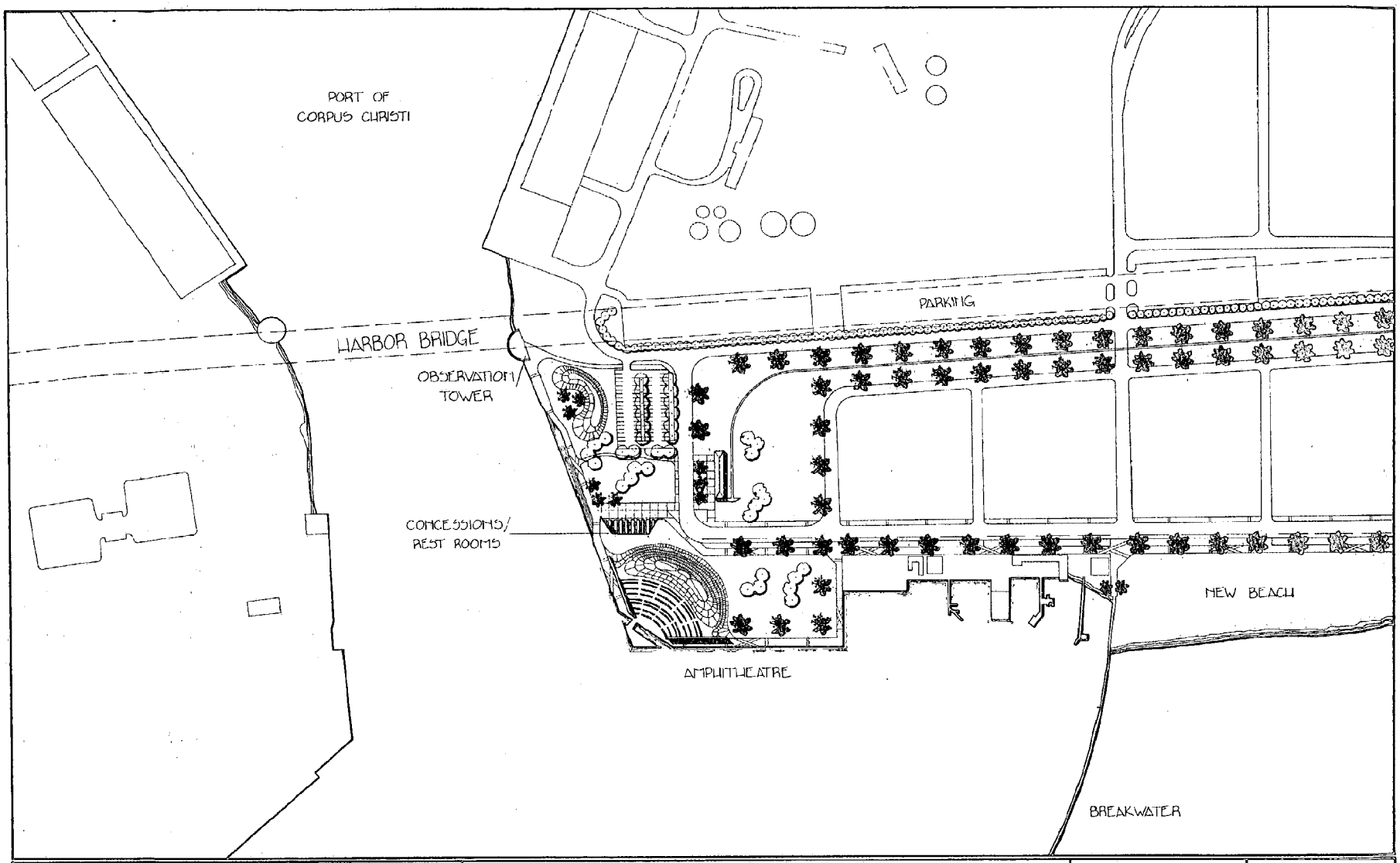
RINCON PARK CONCEPT D

14 SHEET

PLATE 18-4



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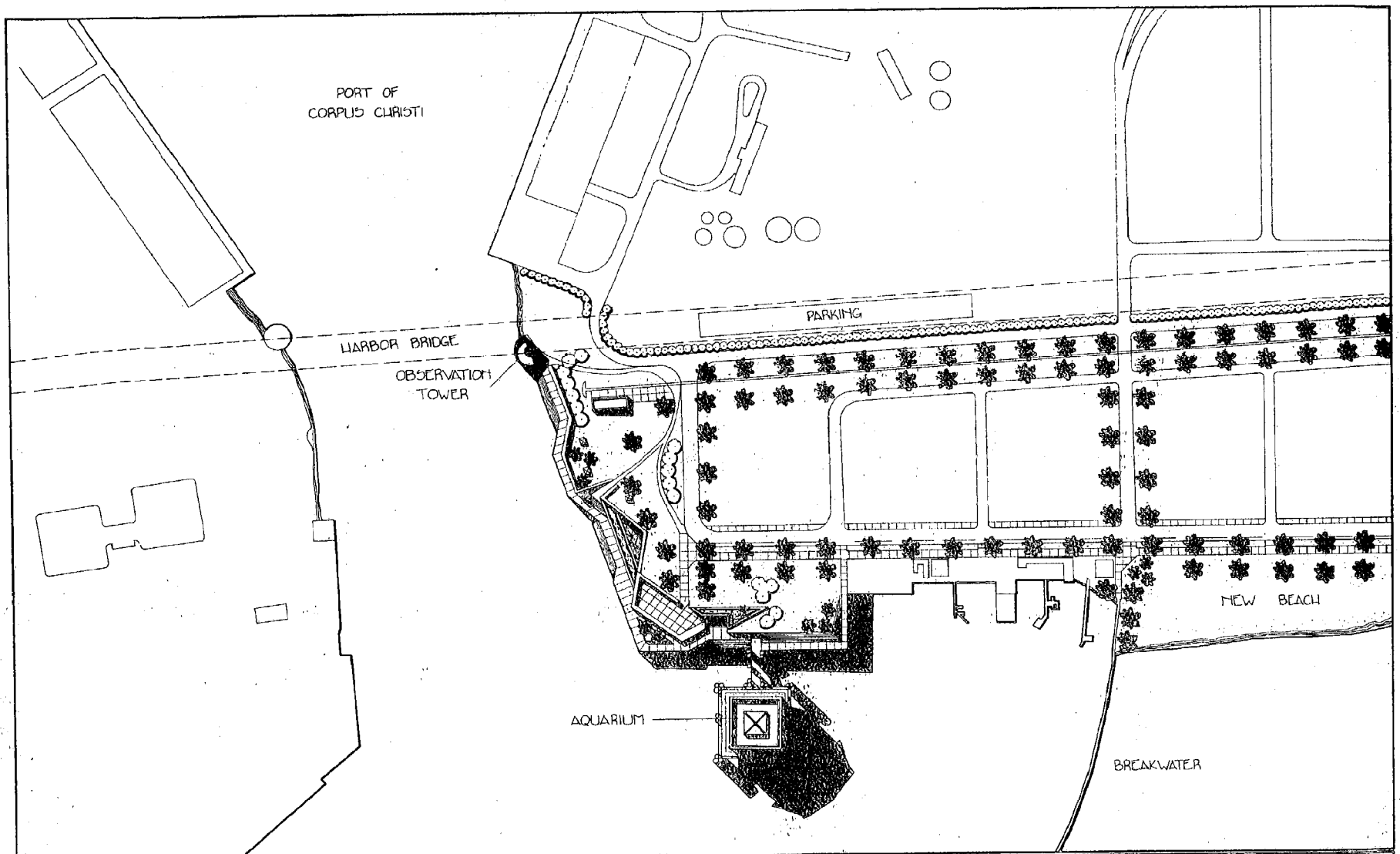
NORTH CHANNEL PARK
CONCEPT 'A'

15
SHEET

PLATE 19-1



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DEVELOPMENT GUIDE PLAN

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UNDER THE SUPERVISION OF DR. W.G. ROESELER, DEPT. HEAD UAPL

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NORTH CHANNEL PARK
CONCEPT "B"

16
SHEET

PLATE 19-2

permanent open space. This facility will be more formal in character in order to relate to the convention center across the channel. There exists, presently, an observation tower, which is used for ship watching in the channel and for fishing; however, it is remote and not as accessible as one would hope.

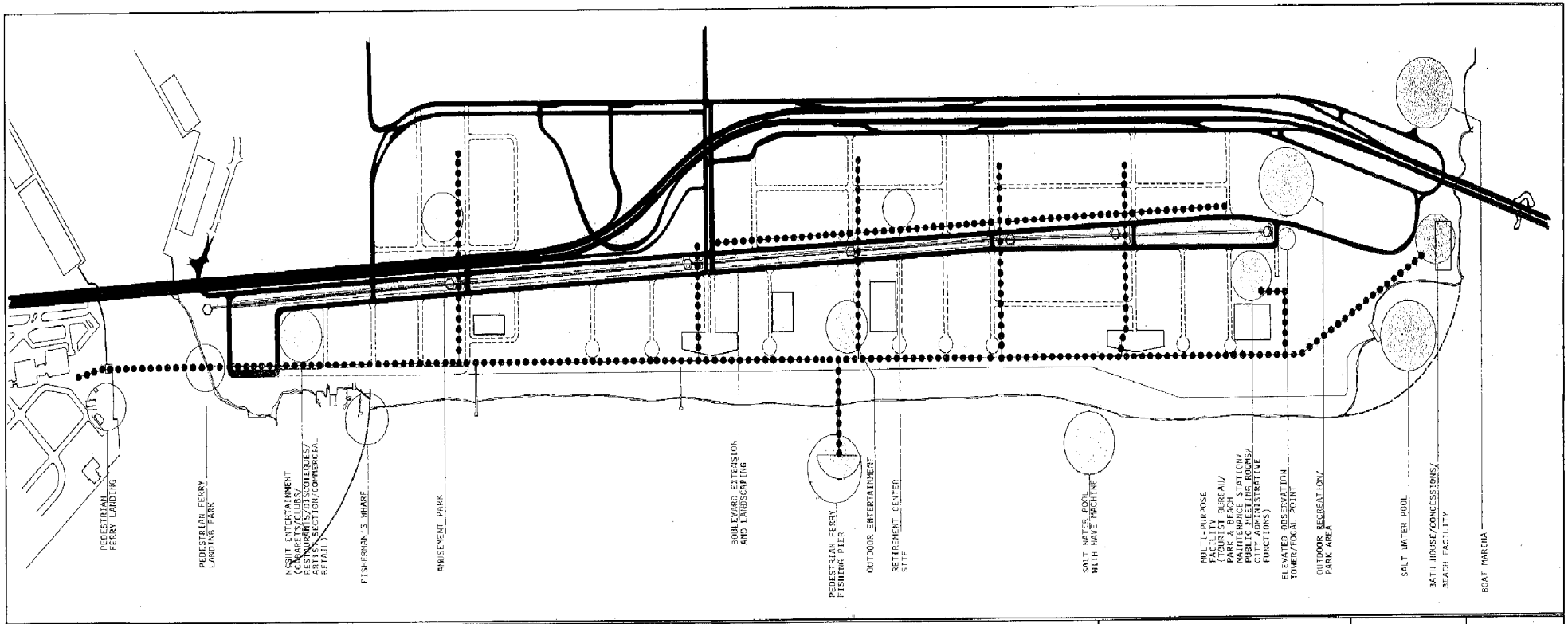
A large amphitheatre with a protrusive stage surrounded by water would feature as its backdrop the skyline of Corpus Christi across the water. A concession area and restroom facilities would be set into the hill created for the amphitheatre seating.

A second alternative for North Channel Park is to locate the aquarium on pilings in the water as a strong architectural statement. Here the pedestrian walk would take on an urban flair with planters, seats and steps built into a series of multileveled retaining walls set at acute angles. Portions of the promenade will link the aquarium to the existing observation tower. Alternating sections of steps, denoting the union of the land and sea, would serve as a visual link to the marina area of downtown Corpus Christi.

Land Use and Growth Objectives

The most desirable arrangement of land uses in any given situation is one which maximizes investment. This is accomplished by working with rather than against natural and given man-made constraints and by effectively avoiding conflicts resulting from inherent or operational incompatibility of land uses. The market place through pricing tends to foster this notion. However, since not all persons in the real estate market are well informed persons with respect to the consequences of ill-advised decisions, regulatory measures - publicly or privately enforced - are needed to realize the full benefits of many outstanding land development opportunities. Corpus Christi Beach represents such a situation. The natural and man-made framework has been described in the foregoing sections. From this framework flows a rational land use pattern as portrayed on Plate 20.

On the south and west Harbor Bridge overshadows all land areas about it. Consequently, lower rise buildings will form a pleasing foreground as seen from the bay. They would best serve commercial, commercial-recreational and similar uses to augment the convention area on the south side of the ship channel. Moving north, Surfside Park creates a natural buffer and an opportunity to change the mood. Between Surfside and Rincon Park the most visable area exists which lends itself perfectly to high-rise apartment buildings, even hotels - market conditions permitting. However, west of the new boulevard, low rise apartments and motels will be more appropriate.



CORPUS CHRISTI BEACH
DEVELOPMENT GUIDE PLAN

GRADUATE RESEARCH ASSISTANT TEAM:
- W.J. GENTILE - URBAN PLANNING TEAM LEADER
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- C.A. HARDING - URBAN PLANNING
- J. WATOOM - GEOLOGY

UNDER THE SUPERVISION OF DR. W.G. ROESELER, DEPT. HEAD UNPL

URPL DEPARTMENT OF URBAN PLANNING TEXAS A&M UNIVERSITY

CONCEPTUAL ACTIVITY NODES

LEGEND

- ACTIVITY NODES
- BEACH WALK

10
SHEET

ACTIVITY NODES

PLATE 20

The Development Guide Plan, Plate 21, indicates that the high land values flowing from beach access can be spread over an area larger than the property abutting immediately the beach. This is accomplished through the superimposition of view corridors which guarantee good exposure to a maximum number of potential sites, Plates 21-1, 21-2, 21-3. Buildings may be constructed freely within the established envelopes giving exposure and views of the bay and the downtown skyline. This method has been effectively used in San Francisco, Seattle and Cincinnati.

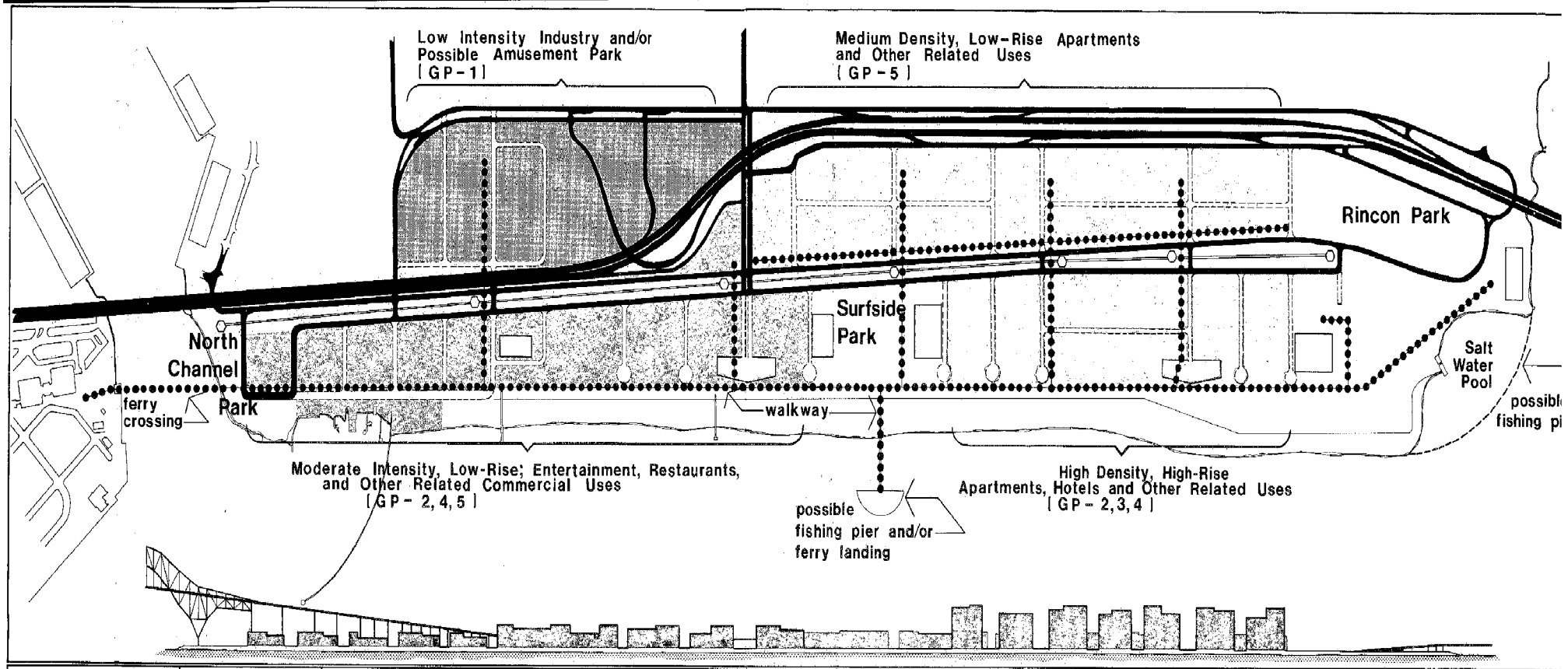
It is advisable to keep the maximum height here under 150 feet. The indicated lower rise areas should not exceed 35 feet. A small industrial or amusement park area west of the bridge on the south side would be kept under 60 feet in height and consist of low-key, low-density uses so as not to adversely impact the resort atmosphere of the main area.

Living and designing with nature requires acceptance of the assets as well as the liabilities. Periodic flooding is a fact of waterfront life in this region. With a high groundwater table it is folly to attempt drainage solutions through complex sewer or canal systems. It is more realistic to simply accept periodic flooding as an inescapable condition and to design buildings and service facilities so as to minimize flood impact.

This is accomplished by arranging the first floor of new buildings in such a way as to allow the water to wash through the structure essentially without obstruction during the onslaught

of the flood and when it recedes. These spaces can be used for parking, of course, or for boat storage.

In arranging new buildings or building groups, the overriding objective of beach access for the public must be held in view. This requires both pedestrian access and parking facilities. The Circulation Plan attempts to accomplish this objective. Under no circumstances should auto traffic or motorcycles be permitted on the beach.



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URPL

DEPARTMENT OF URBAN PLANNING TEXAS A&M UNIVERSITY

GENERAL DEVELOPMENT GUIDE PLAN

DEVELOPMENT GUIDE PLAN

PLATE 21

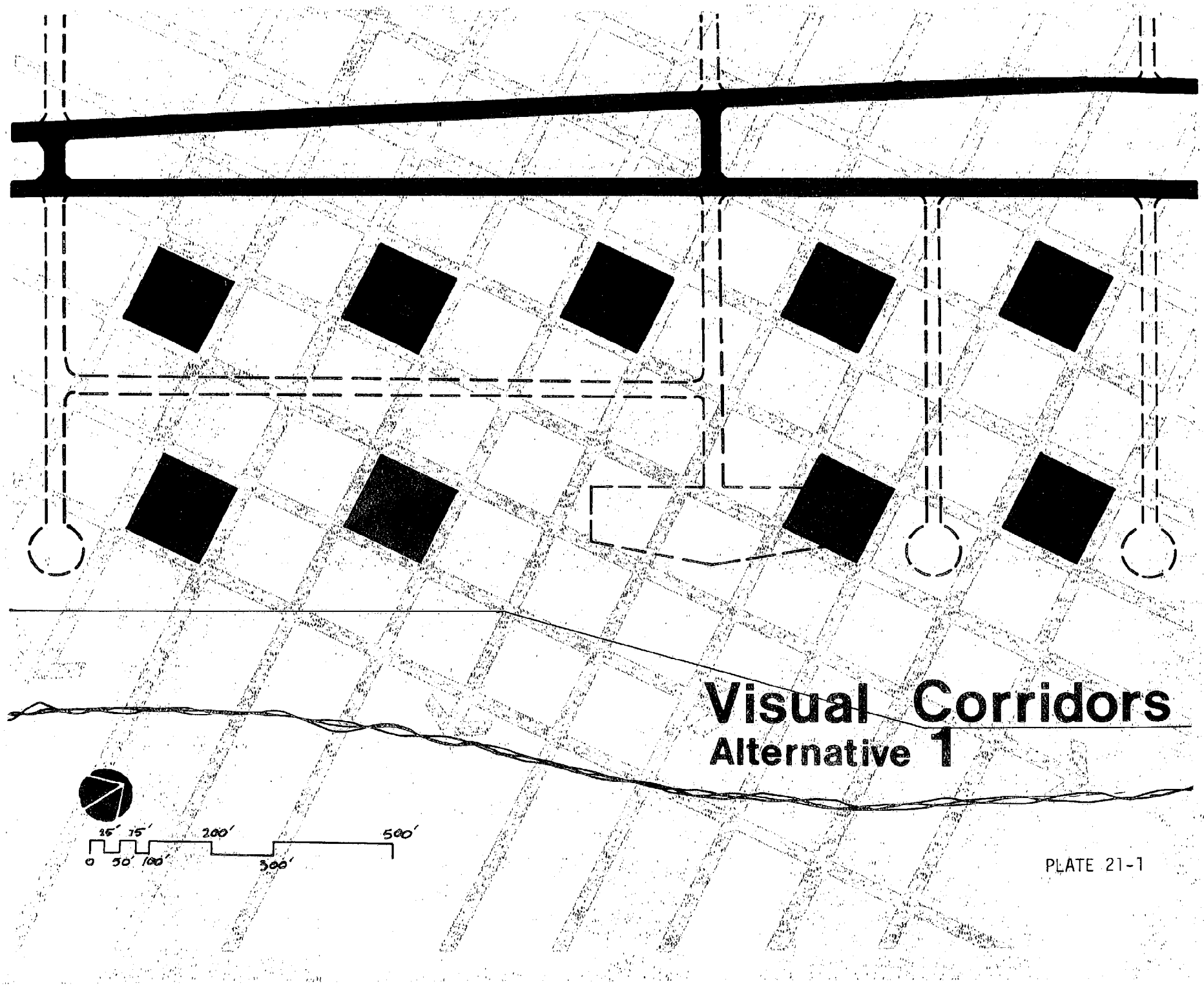
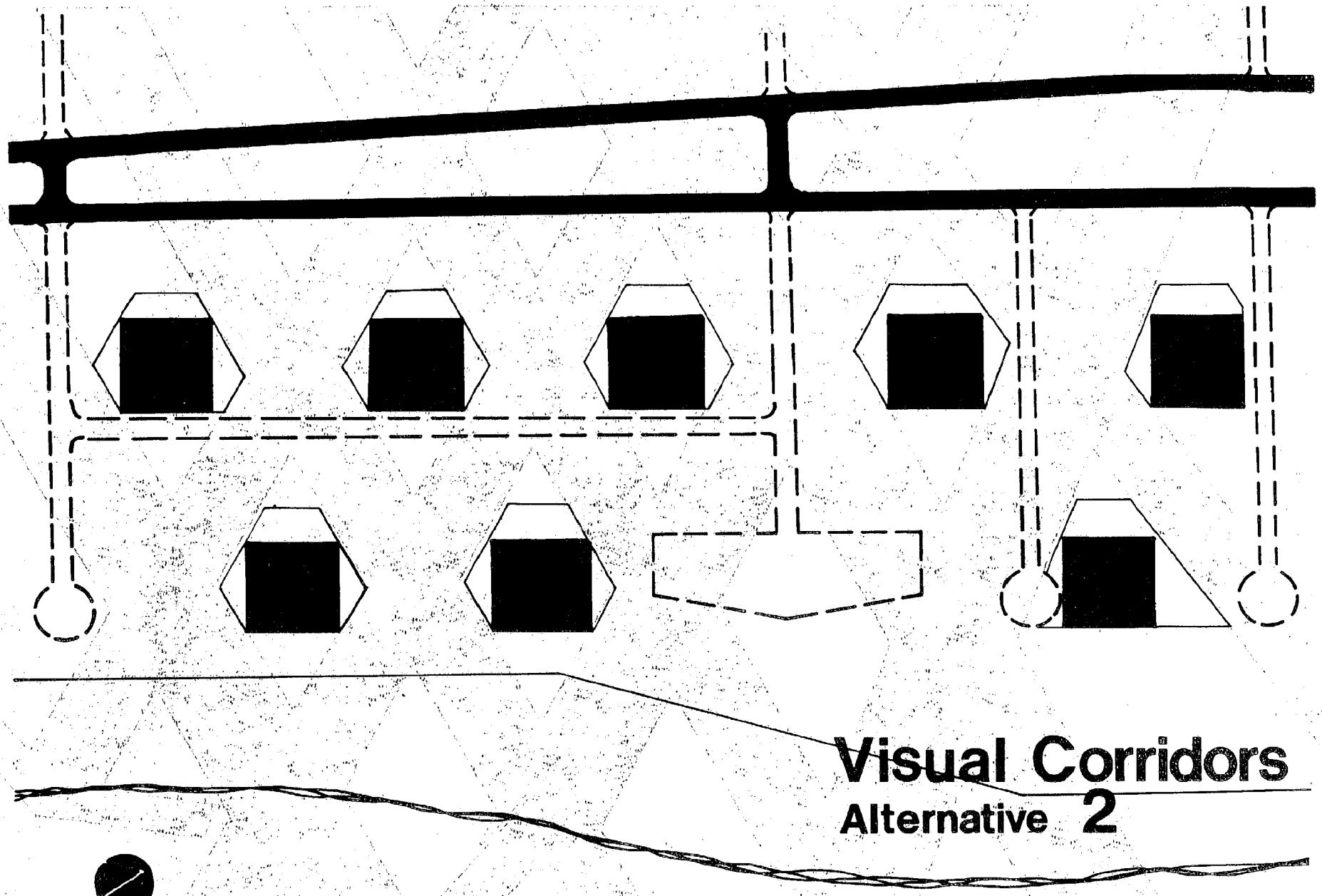


PLATE 21-1



Visual Corridors
Alternative 2

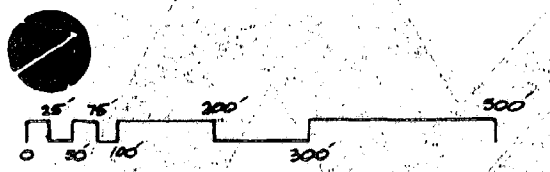


PLATE 21-2

Visual Corridors
Alternative 3

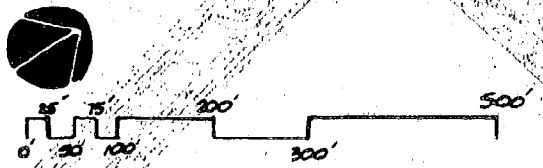


PLATE 21-3

Relates setback requirements on each story; present on every visual corridor.

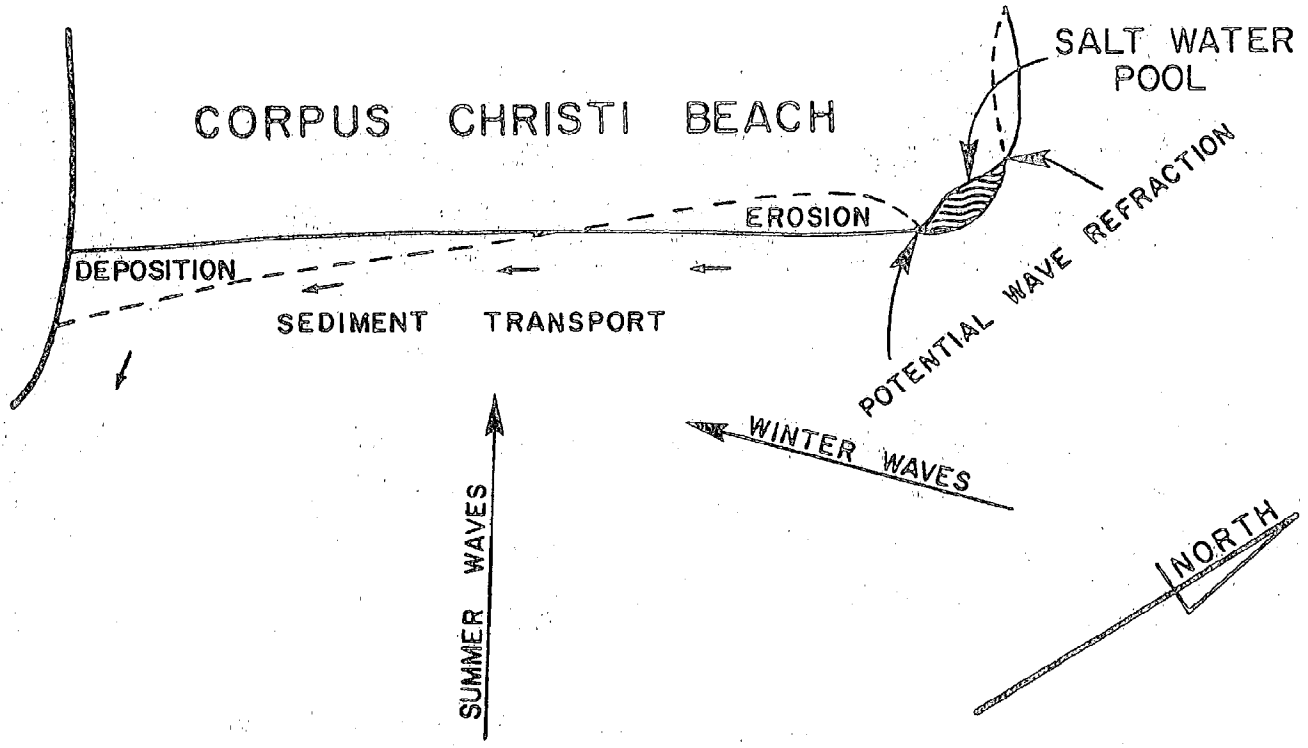
Saltwater Pool

It has been proposed in the conceptual design of recreational facilities for the Corpus Christi Beach that an enclosed saltwater pool should be constructed at the north end of the beach for swimming and recreational use. This has the advantage of providing calmer waters as well as allowing control of certain unwanted marine life, in particular, jellyfish. The design includes an impermeable, semicircular breakwater, enclosing the north end, with circulation by pumping. The proposal is feasible and would enhance the tourist value of the area. However, it has been suggested that this type structure may impose some detrimental effect on the natural sedimentary processes of the beach.

In evaluating the sedimentary processes, it is concluded that this structure would have a minimal effect on the natural supply of sediment to the beach. As previously stated, the absence of a strong longshore sediment influx indicates that little southward moving sediment would be trapped at the north side of the structure. This diminishes the possibility of depleting the rest of the beach of naturally supplied sediment from the northeast. However, consideration should be given to local effects of wave refraction and longshore currents about the breakwater. As illustrated in the schematic, Plate 22, refraction may tend to create a concentration of wave attack on either side of the pool, resulting in increased erosion in those areas. Longshore currents induced by these waves may also cause increased erosion

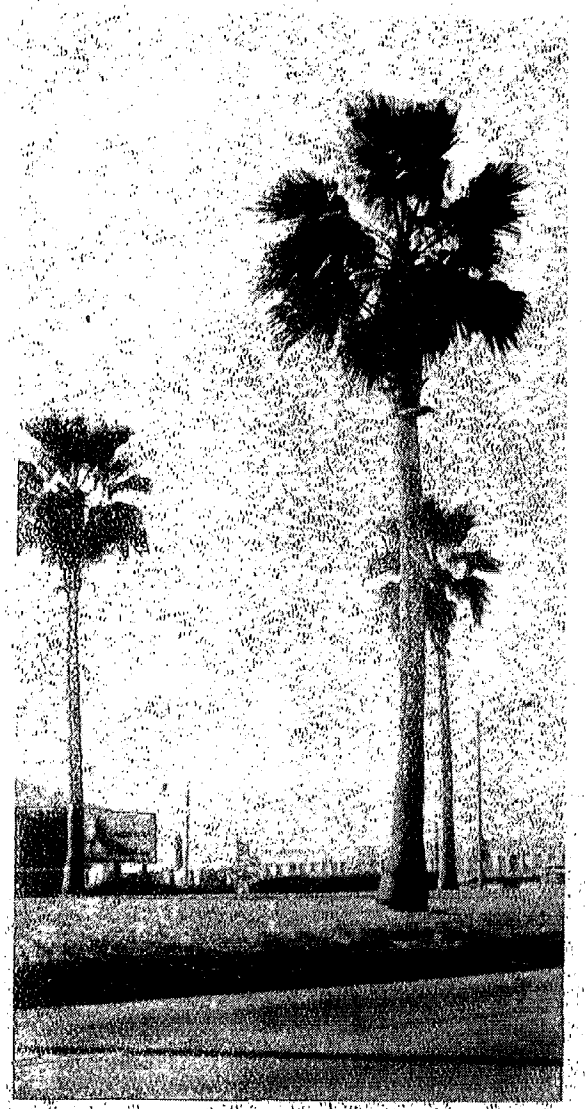
of the new beach in the immediate area south of the pool, accompanied by deposition against the breakwater at the south end of the beach. If such a situation develops, the erosional material can be salvaged before it is lost offshore, and mechanically transported back to the pool area. However, considering the low energy and slowness of these processes associated with normal weather conditions, and owing to the necessity for periodic artificial nourishment of the entire beach, the pool should not create significant difficulties in maintaining the beach.

An advantage of the saltwater pool is in the protection that it would offer the beach immediately behind it. The enclosing breakwater would effectively isolate this portion of the beach from wave attack and longshore currents. It is concluded that construction of the pool is feasible and practical in terms of these considerations. However, further studies should be conducted to assess the scouring in the immediate vicinity of the pool for the final design of the breakwater.



Swimming Pool Wave Impact

PLATE 22



Implementation

Public Policy

The implementation of any public planning effort calls for both public investment based upon firm commitments by the political body having jurisdiction, and regulatory measures designed to protect the public investment on the one hand and - most importantly - to attract private risk capital to essentially bear the lion's share of the venture.

The Corpus Christi Beach program as outlined in this report, obviously, will call for rather substantial public expenditures. To begin with, the city and federal government - through the Army Corps of Engineers - are investing 2.2 million dollars for beach restoration. The public will demand parking facilities and adequate streets and utilities to support use of the beaches. But the program of development will call for additional facilities and services. No useful purpose would be served by estimating the costs involved as the public facilities recommended will most certainly not be constructed all at once, but over a long period of time, unless, of course, sudden major private investment is realized.

Under conditions such as those prevailing in the project area, one must carefully monitor public investment response. The regulations described in the following chapter are designed to assure the prudent investor - not the "fly by night, quick profit taker" - of stability and, conversely, the tax payer of Corpus Christi that for a prolonged period of time a highly desirable recreation

area will exist to serve this city. Consequently, general policies and strategies must be recognized and observed by the City Council in years to come to attain this objective to which apparently all can readily agree. What then are these policies?

At the outset, a prudent, unbueaucratic attitude on the part of the city government is essential as has been demonstrated on other occasions by the City. The area is so sensitive and relatively small that each project must be carefully evaluated on its merits from a design standpoint. Conversely, the developer is entitled to certainty as to the City's attitude. To achieve this, the proposed regulations below essentially require adherence to the land use categories of the Development Guide Plan and the corresponding conditions of construction. This can be achieved by the ordinance adopting this plan. This procedural step becomes an essential ingredient of the system. Once the plan has been adopted, the land owner is certain that the specified uses will be permitted. The decision will have been made whether or not a highrise hotel can be constructed on a certain site and the usual zoning "game" will have been dispensed with. However, the manner in which the development is to be executed, the specific design features are to be discussed and negotiated only when the developer is ready to move.

The lender will have certainty, both at the level of the local bank and with respect to the long-term investor which normally will be one of four or five national insurance companies. The developer

and land owner shares in the certainty, yet the City has not given a blank check which it cannot afford anyway as is by now generally recognized for the reason that it too must invest in the area to support the privately financed projects. To do so required certainty with respect to tax stability. This can only be attained through regulations which will induce superior design so that the full potential of every parcel in this sensitive area can be realized. This is accomplished through a process somewhat similar to the planned unit development concept of the present zoning system.

Having adopted the Guide Plan, nothing happens until the developer is ready to construct. Presumably, the original land owner has by now sold his property and realized the highest possible return - all because City Council had committed itself to the Guide Plan. The developer/owner has negotiated with the lender and has his required commitments. He now applies for activation of the zoning classification which corresponds to the Development Guide Plan in the area where he is located. This now becomes merely a ministerial act as the policy has been previously established. The zoning change is contingent upon approval of precise plans, and this again is done in two stages, just like a subdivision plat. In fact, zoning and subdivision procedures are molded into a single instrument to cut out unnecessary paper work.

The developer will cause demand for services and improvements of various kinds. How does the City cope with this issue? It will each year have its various departments compile capital improvement requests. Since the Department of Community Development and Planning was established for just

that type of operation it is reasonable to direct it to take the initiative in the process by preparing - in cooperation with all other municipal agencies concerned - an annual capital improvement report to the city manager who, in turn will do what he can to reconcile conflicting requests for funding. As any other matter of municipal management concern, public policy will have to be determined from time to time to reflect priorities in funding based on the overall needs of the community. Consequently, the public investment will reflect the level of demand generated by private investment and, at times, may well result in coordinated financial commitments by both the public and private sector. On this basis, the Development Guide Plan becomes an effective instrument of action toward the stated objective of waterfront development and beach access to the public in various forms.

Corpus Christi Beach Development District Summary

To achieve the desired design objectives, land use, height and bulk constraints, visual corridors a special development guide plan would be needed. A planned unit development type procedure would be the most desirable approach, however, on a much larger scale than traditionally used. The basic concept consists of bringing the entire project area under one development plan, therefore providing a sound balance between land utilization, public service and beach access. At the same time, it will give the developer certainty about the kind of zoning and development requirements he may expect. The following district classifications are suggested:

Industry - GP-1 district is designed to accommodate manufacturing establishments which are free of objectionable influences in their operation and appearance, or which can control any objectionable feature resulting from the manufacturing process by installation of abatement devices.

Office Building - GP-2 district will accommodate office buildings.

High Density Residential Uses - GP-3. The purpose of this district is to permit high-rise residential structures such as apartment buildings, condominiums, cooperative hotels, and apartment hotels.

Retail Commercial Uses - GP-4 district will accommodate retail business and certain personal and professional services in integrated shopping centers, either as independently established development units or as part of a large development project providing other uses as well.

Medium Density Residential Uses - GP-5. The purpose of this district is to provide for all forms of residential development at a medium density ratio, such as single family residences, garden apartments, and townhouses, in addition to institutional uses, e.g. churches and schools.

Beach and Waterfront Conservation Uses - GP-6. This district applies to the beach area and to areas where open space is intended within the land use plan, including areas subject to flooding, or areas where topographical difficulties exist, or in areas where conversion to an urban use is not intended in the forseeable future. It is also a "holding" district applied to any even until the zoning which corresponds to the Development Guide Plan can be activated.

The districts, once established, are also defined as to the acceptable uses permitted within a geographic location. For example, in a particular area, GP-2, (office building) could have a reasonable mixed use in the form of GP-3 (high density residential), GP-4 (retail commercial), or GP-5 (medium density residential). It is desirable, however, that GP-3 and GP-5 not be permitted in the same geographic location because of conflicting uses.

Along the waterfront, the acceptable uses would naturally consist of a mix of GP-2, GP-3, GP-4 and GP-5 as this location has the highest rate of return to the investor. However, as mentioned each geographic area would be subject to height limitations, for structures competing with the bridge for dominance of the sky line would make the existing situation worse.

Area 1, for instance, from the North Channel Park northward to Coastal Avenue, would allow GP-2, GP-4 and GP-5 uses, with a height limitation of 40 feet. This low profile will in no way interfere with the Harbor Bridge in the background.

Area 2, north of Coastal Avenue to Surfside Park and east of Surfside Boulevard, would also allow the same uses, but the height limitation could be increased to 60 feet.

The third area, located between Surfside Park and Rincon Park east of Surfside Boulevard, will have a mixed use of GP-2, GP-3 and GP-4. The maximum height in this case would be limited to 120 feet. This area is a balancing point between the Harbor Bridge and the urban areas.

Area 4, west of Timon Boulevard extends from Burleson Street northward to Rincon Park. It would be limited to only GP-5 and its permitted uses with a height limitation of 60 feet forming a visual base for the high rise structures of Area 3.

A small area between Burleson Avenue to the north and Timon Boulevard to the east would be best suited for GP-4 since excellent access is available.

The industrial use is limited to Area 6, west of Highway 181 and north of Breakwater Avenue. This area is bordered by industrial uses to the west and south, therefore these abutting land uses dictate this industrial district.

An innovative concept of this land use plan is the emphasis placed on visual corridors. Visual corridors are restrictive open spaces arranged in such a manner to allow residents of Area 4 a visual connection with the Gulf. These corridors will criss-cross the site leaving void areas as acceptable building sites.

Three alternative plans were studied, each having the same constraints, Plates 21-1, 21-2, 21-3. These constraints included vistas, a 20,000 square foot floor area, existing condominium, street right-of-way, and set-backs. The only variables were the allowable number of structures per geographical area and building orientation.

The first alternative allows for wide visual corridors but limits the design and orientation of the structure. The amount of land available to an investor is extensive, however, the buildable area is limited, therefore yielding a low rate of return.

The second alternative provides for an orientation similar to the existing condominium, but with very narrow visual corridors. In addition, the number of structures is increased to nine (9) therefore lowering investment costs but allowing no flexibility to the design of the structure.

The final alternative makes use of the same orientation, however, the building's location is shifted to the north, and the angle of the corridor is changed slightly. With these changes the desired effect is achieved, a visual corridor of 30 feet in width and each structure having an exciting view of Corpus Christi and the Gulf of Mexico. This particular arrangement provides for the most flexible building sites without limiting the imagination of the developer. However, it is believed that the best orientation is the one presently indicated.

? how does this plan assure maximum for walkways & parking.

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